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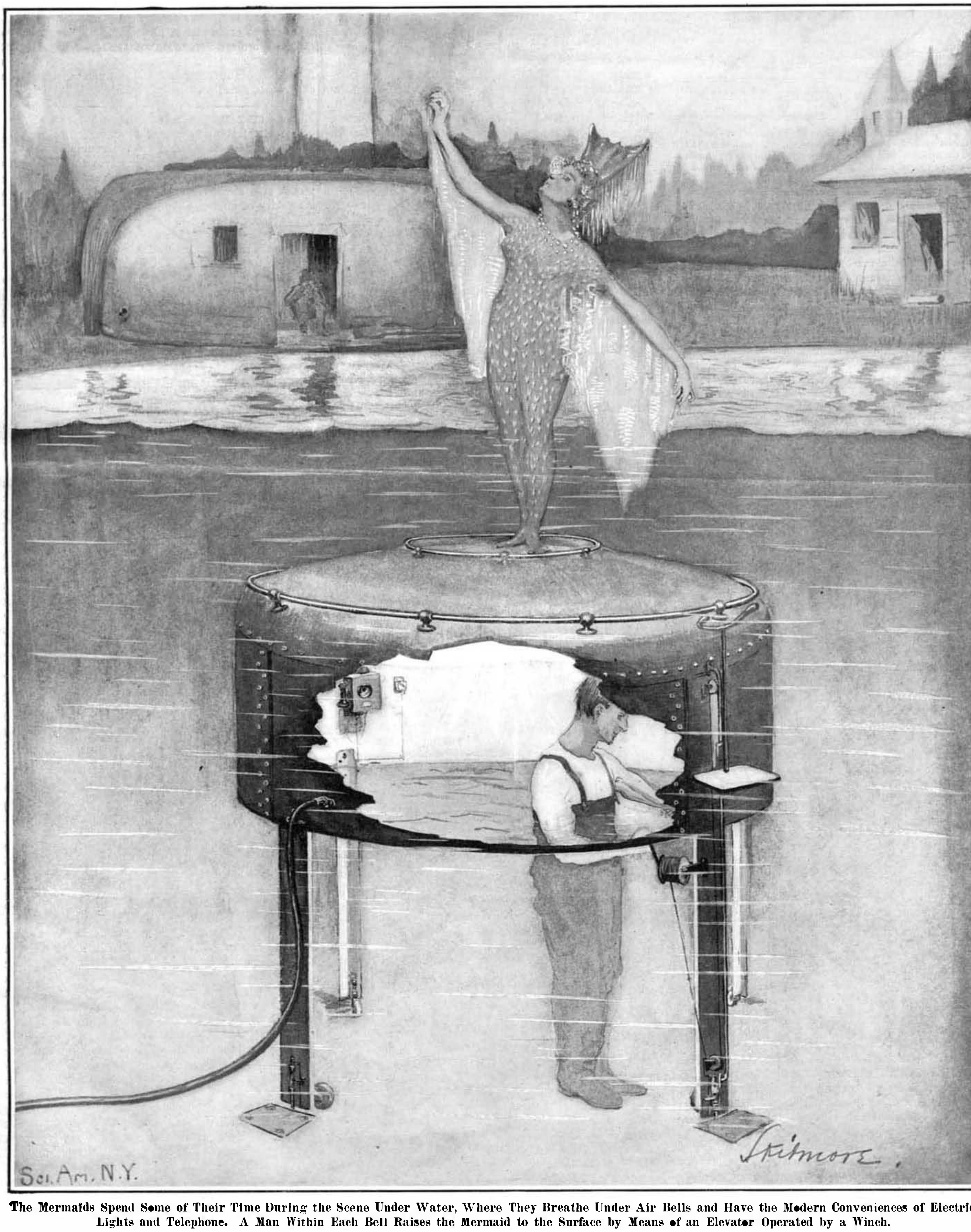

The Mermaids Spend Some of Their Time During the Scene Under Water, Where They Breathe Under Air Bells and Have the Modern Conveniences of Electric Lights and Telephone. A Man Within Each Bell Raises the Mermaid to the Surface by Means of an Elevator Operated by a Winch.

THE MYSTERY OF THE HIPPODROME MERMAIDS UNVEILED.—[See page 332.]

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NEW YORK, SATURDAY, APRIL 20, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE SCIENTIFIC AMERICAN AERONAUTIC TROPHY.

Despite the fact that very many inventors throughout the United States are wrestling with the problem of aerial navigation by means of a true dynamic flying machine, that is, a machine heavier than air, no public flight has been made in this country with such a machine up to the present time. The most advanced knowledge of heavier-than-air navigation seems to be held by two young western experimenters, of whom much has been written. These men have undoubtedly made flights with their aeroplane, and these flights have been witnessed by a considerable number of people. The general appearance of their machine is known, and other experimenters are making good progress along somewhat the same lines.

We feel, therefore, that the time is ripe for the offering of a suitable trophy commemorating the conquering of the air by a heavier-than-air machine. As the SCIENTIFIC AMERICAN is the oldest journal in this country treating of Science and the Arts, its proprietors feel that it is fitting that this journal should be the first to encourage the development of the latest great invention—a machine that shall conquer the air. The proprietors have, therefore, decided to offer a valuable trophy for competition for heavier-than-air flying machines. The trophy is to be given under a deed of gift to the Aero Club of America, to be competed for annually by both American and foreign inventors. The rules for the competition will be drawn up by a committee of the Aero Club, and it is expected that the first competition will occur at the Jamestown Exposition, September 14, and will be for a flight of one mile or less in a straight line. The competition is to be progressive in character, that is to say, if the flight of the predetermined distance is accomplished this year, next year a longer flight will be required, or a flight of a mile with turns. In other words, the conditions of the yearly contests will be such that they will be just ahead of the art, in order to induce inventors continually to strive to improve and perfect their machines. Should any one inventor win the prize three times, it will then become his property.

Further particulars regarding the first competition will be given from time to time in the columns of the SCIENTIFIC AMERICAN.

BROKEN RAILS AND RAILROAD ACCIDENTS.

It is a significant fact that, side by side with the alarming growth in the number of railroad accidents which has been noticeable during the past winter, there has been an increasing frequency in the breakage of the steel rails, upon which, after all, the security of railroad travel immediately depends. There is evidence that not a few of the disasters have been caused directly by these broken rails; and there can be little doubt that many of the unexplained accidents have been due to a similar cause. According to one of our technical contemporaries, an engineer who was present at a recent railroad wreck stated that, within a distance of one mile in the vicinity of the wreck, he counted nineteen broken rails which had been removed from the track during the winter.

The writer was recently given an opportunity to examine an official report, made to the president of a certain trunk line, on the subject of broken rails; and he was dumbfounded to learn that, during two months of the present winter, there had occurred on this road over 600 cases of broken rails. When we remember that every such break puts the trains in immediate peril of derailment, we are filled with wonderment, not that there are so many, but that there are so few, disastrous accidents.

Time was when American rails, bought in the open market and rolled to the specifications of the engineers of the railroads, and by them held strictly to these specifications, were equal to any in the world. To-day the rails that are received from the one colossal concern which can furnish them, are of the very poorest quality—a constant and positively fearful menace to every passenger that rides over them.

The depreciation, rapid depreciation, in the quality of rails is due to the introduction by the makers of cheaper and quicker methods of manufacture.

These methods have been adopted with a single eye, not to the improvement of quality, but to the increase of profits on the output.

That the broken rail is a growing peril will be realized, when we state that, during the past few years, the rails supplied to the railroads by the concern which has the monopoly of their manufacture, have become so poor in quality, that breakages have gone up several hundred per cent.

And every broken rail is an invitation to a railroad disaster!

The blame for the present alarming conditions lies then at the door of the manufacturers. This fact will be fully appreciated, when we have made the American public familiar with certain astounding facts in the recent history of the relations between the railroads and the one concern upon which they are dependent for rails.

THE CRUISER OF THE FUTURE.

The recent launch of the British first-class cruiser "Indomitable" marked the advent among the fleets of the world of the most notable warship of the day. In saying this, we do not exclude even the "Dreadnought," epoch-making vessel though she was.

The "Indomitable" is so entirely unlike any other warship as to be quite in a class by herself. She is swift enough to overtake, and powerful enough to sink, the fastest cruisers that are afloat on the high seas to-day. Were the most formidable battleship to attack her while she was destroying her quarry, she could swing her guns upon the ship, and overwhelm it by pouring in a long-range armor-piercing fire from her battery of eight 12-inch guns. Armed, as she will be, with a new pattern of 12-inch rifle, of considerably greater range and hitting power than any naval gun afloat to-day, she would be a fair match, if we except the Japanese "Kashima" and "Katori," for any two existing battleships that might be opposed to her; for with her high speed of 25 knots an hour at command, she could choose her own bearing and range, and place her shots in greater numbers, and with greater remaining energy at the range adopted, than could the enemy. By taking position where the shells of the enemy must strike her armor obliquely, her 7 inches of face-hardened Krupp steel protection would, at the long range selected, be proof against a vital penetration.

The leading particulars of the "Indomitable" and her sisters the "Inflexible" and "Invincible" are as follows: Length, 530 feet, or 30 feet more than that of the largest cruiser afloat; beam, 78 feet 6 inches; draft, 26 feet; displacement, 17,250 tons; horse-power, 41,000; and speed, 25 knots. Although the armor is not so heavy as that usually carried on the battleships (though it equals that of the "Duncan" class) it covers almost the whole of the hull, being carried nearly to the level of the upper deck. It has a maximum thickness of 7 inches amidships, and tapers to 4 inches at the ends.

Next to her speed, the most surprising feature of the "Indomitable" is her armament, which consists of eight 12-inch guns—twice the number carried in battleships—carried in four turrets, one forward, one aft, and one on either beam, the last-named turrets being placed *en echelon*, or diagonally to the center line of the ship. This renders all of the 12-inch guns available on either broadside, and enables the "Indomitable" to concentrate six 12-inch ahead, six astern, and eight on each broadside. The high freeboard of these vessels will enable them to fight their guns in heavy weather, since both the forward turrets and the two wing turrets are carried at a height of from 34 to 36 feet above the water line, the after pair of guns being about 26 feet above the water line.

The growth in power of the cruisers of the British navy in the past seven years has been very striking, the displacement having nearly doubled and the collective muzzle energy from one single round of all guns having increased over twelve times. Thus, the "County" cruisers of 1900 were of about 10,000 tons displacement, and the total muzzle energy of one round was about 30,000 foot-tons. The "Drake" of the following year, of 14,100 tons, has a collective muzzle energy of 64,000 foot-tons; the "Duke of Edinboro" of 1904 can deliver a total energy of 100,000 foot-tons; and the "Minotaur" of 1906, 137,000 foot-tons; while the "Indomitable" of 1907, displacing 17,250 tons, has a collective muzzle energy from one round of her guns of 381,000 foot-tons. Furthermore, while the 6-inch guns of the "County" class of 1900 have an effective fighting range of 3 miles, and the "Drake" can do effective work with two of her guns (the 9.2-inch) at 4 miles range, and the "Minotaur" class can use four guns at the same range, the "Indomitable" will be able to bring to bear the whole of her eight guns at 5 miles range, and engage at this range on equal terms of gun fire any two battleships, with the single exception of the Japanese ships, now afloat.

The *raison d'etre* of the remarkable combination of high speed and heavy armament in these three cruisers is to be found in the necessity of getting in touch with the enemy; breaking through his outer screen of scouts and cruisers; determining the exact strength of his battleship squadron; and returning with the information thus gleaned for the guidance of the admiral of the fleet. For such work the "Indomitable" class are perfectly suited, their power being sufficient to enable them to crumple up the scout and armored cruiser formation of the enemy, and their speed sufficient to bring them safely away, after drawing the fire and determining the numbers and power of the enemy's first line of battle.

SUSTAINED ELECTRIC OSCILLATIONS.

The simplest method, and practically the only one hitherto employed, for obtaining currents of sufficiently high frequency to emit electric waves suitable for the transmission of wireless telegraph messages, is by means of a spark set up between the terminals of the secondary of an induction coil.

The opposite arms of an oscillator thus formed are the equivalent of a condenser, and hence when the pair of surfaces are discharged the circuit at the moment the spark passes has a negligible resistance and in consequence the negative and positive electric charges are permitted to equalize the difference of potential and the released energy to surge through the system in the form of high frequency currents or electric oscillations.

This phenomenon is due to the fact that a very small portion of the static, or stored-up, energy is required to burn out the air forming the insulating partition between the terminals or spark-balls, while the larger portion of the energy which is suddenly released and converted into kinetic electricity, and which is under a very high pressure, rushes first to one end of oscillation circuit, then back to the opposite end of the conductor, each time passing through the spark-gap, whose resistance is no longer of appreciable value, and so repeating the cycles of oscillation until the total energy is damped out by the emission of electric waves and other resisting influences.

If the oscillation circuit is an open one, that is if the opposite sides of the spark-gap are connected directly to conductors that end abruptly, or are open at both ends, the energy of the oscillations is very quickly converted into electric waves, the high frequency currents being damped out in two or three swings. Oppositely disposed, if the oscillation circuit is a closed one, that is if the circuit forms a loop and is continuous, the oscillations surging in it will be more persistent and the currents thus set up within it will swing thirty or forty times back and forth, depending on its electrical dimensions.

By the term electrical dimension is meant the capacity, inductance, and resistance of the circuit, and on these factors depends the frequency of the oscillations, which may surge at the rate of from thousands to millions of times per second. It must be borne in mind, however, that these high-frequency currents are by no means continuous in character, but are periodic, and decrease in geometric ratio reaching zero in a very small fraction of a second. By using a closed circuit instead of an open one, the decrement of the oscillations may be reduced, a shorter period of time will elapse between each successive series of swings. It is during this time that the oscillation system is recharged for the next succeeding discharge.

In wireless telegraphy the open circuit system possesses the advantage of sending out electric waves that are more penetrating than a closed circuit, while the latter is, in virtue of the persistence of its oscillations, which more nearly approach a sine wave form, much better adapted for producing sympathetic electrical resonance, so that an oscillating current set up in the first or transmitting circuit will start a series of oscillations of a similar frequency in a second or receiving circuit.

From the preceding it will be clear that both open and closed circuits possess certain commendable features for the emission and reception of wireless messages, and indeed these have been combined in what are termed compound systems which are well adapted for the production of resonance effects. By employing such compound circuits it is possible to receive at will one of two incoming messages of the same strength, but this is as near selectivity as can be obtained with periodic oscillations produced by a spark-gap, however feebly damped the former may be.

Fortunately there are other methods known by which high frequency currents can be set up, and in which the usual spark-gap plays no part, and yet more fortunately the oscillations thus produced are continu-

ous and constant in amplitude. One of these methods for the conversion of direct currents into high frequency oscillations was described in a recent issue of the SCIENTIFIC AMERICAN, and as it was then pointed out, the system utilizing it gives much promise of sŏlving the problem of selective wireless telegraphy.

Elihu Thomson was the first to discover that a direct current could be converted into an alternating current by shunting a suitable capacity and inductive around an arc light. Duddell then showed that by varying the coefficients of the shunt current the arc would emit a continuous musical note. The alternating currents thus produced represented a very small percentage of the direct current impressed upon the arc light and further, the currents thus obtained were of comparatively low frequency, being the equivalent of the musical note emitted, and these were, of course, much too low for the radiation of effective electric waves. Poulsen has recently found that if the arc is produced in an atmosphere of hydrogen or other gases, oscillations will surge through the circuit that are of the order of hundreds of thousands per second.

The object of inclosing the arc light in hydrogen—illuminating gas suffices very well—is due in a measure to its cooling effects, for the oxygen is excluded. It has been further ascertained that by placing the arc in a strong magnetic field the voltage drop in the arc is quite low considering its unit length, that is to say, it requires 440 volts to produce an arc ⅛ inch in length. Where these conditions prevail, it is possible to increase, within certain limitations, the inductance of the circuit without further increasing its capacity, and this permits the potential difference of the terminals of the circuit to be larger than would otherwise be possible.

The principles of resonance that have been so carefully and laboriously worked out in the past will not be lost in the commercial application of the new method, for without the knowledge of timing the circuits continuous oscillations would prove of but little worth. With a transmitter of the hydrogenic arc type and a receptor in which the oscillation circuits are arranged so that the damping factor is reduced to the least possible extent, the degree of accuracy of timing is said to be about one per cent, namely, that two stations equipped with this apparatus may communicate with each other with waves of 600 yards in length and two other stations at the same time in the same field of force with waves 606 yards in length and without any untoward result of interference. Since wave lengths varying from 300 to 3,000 yards may be used, several hundred stations may cover the same territory without suffering from the effects of the others.

There are methods other than the one cited by which continuous oscillations can be produced, but with the results already obtained there is sufficient encouragement to warrant a belief that the limitations which hedged in wireless telegraphy are to be greatly extended within the next few years, and its usefulness, now generally recognized, will prove a more potent factor than ever in the transmission of the world's intelligence.

ADVANTAGES OF TURBINE PROPULSION FOR BATTLESHIPS.

BY H. C. DINGER, LIEUTENANT UNITED STATES NAVY.

Repeated comments and the charges of uncalled-for unprogressive conservatism in the Navy Department for not requiring turbines for the propelling machinery of battleships, have caused me to think that the setting forth of some particulars of underlying information regarding the relative merits of turbines and reciprocating engines might be of interest. It must be granted that if turbines (a new and unfamiliar system of machinery) are to be adopted in place of reciprocating engines (an old and familiar system), they should have proven, beyond a reasonable doubt, one or more paramount advantages, which will warrant the making of the change.

What are the advantages of turbines for propelling battleships? The following are sometimes urged: Reduction in weight and space, greater simplicity, less attendance, greater economy, absence of vibration.

Reduction in Weight and Space.—This is a chimera, which may sometimes be found in theory, but has not been proven in practice. The actual marine turbine may weigh slightly less than the best type of reciprocating engine of the same power, but the increase in condensing apparatus and other auxiliaries necessary to the proper operation of the turbine will about balance this saving. Apropos of this, a somewhat misleading comparison has recently appeared in scientific magazines, where the reciprocating engine of a battleship, of a design six or seven years old and built to suit battleship practice, is compared with the turbine of a scout of four years later design and built on the weight schedule of a torpedo boat. A rather fairer comparison might be made by taking the reciprocating engine of the scout's sister ship, which is of same power. Had this been done, the startling advantage in weight for the turbine would have vanished, as would also the great discrepancy in size. For heavy fighting vessels, turbines have, thus far, not demonstrated that their use will produce a material reduction in weight. Neither is there any very material gain in floor space, if the machinery is installed with an idea of doing any overhauling. Head room is gained, but a great deal of space is necessary for lifting the casings. Large hatches are even more necessary than with reciprocating engines, so that the space that could be gained by the turbines in battleships is extremely slight.

Greater Simplicity.—While the turbine principle is of itself more simple than that of the reciprocating engine, the whole arrangement of the motive power of the type of turbines most in vogue, the Parsons, is not as simple as for an arrangement with reciprocating engines. In the Parsons system the power is developed upon four shafts in place of the two in ordinary use. This naturally leads to some complication and, it may also be remarked, will make it much more difficult to quickly change the direction and speed of these engines for maneuvering purposes. It will naturally be somewhat more of a problem to handle a vessel with four screws than one with only two; and this is something to consider, when quick and reliable maneuvering ability is one of the essential qualities that a battleship should have.

The adjustments of the turbine engine will require considerably greater accuracy than those for a reciprocating engine, and the ill-effect of mal-adjustment is much more serious. Due to slight inaccuracies in alignment, there is danger of many blades being torn out by striking the casing. A hot bearing becomes a very serious matter, since the melting of the white metal is liable to cause the ends of the blades to strike.

The turbine requires the same auxiliaries as the reciprocating engine and a few additional ones, besides larger condensers and air pumps.

There is practically no difference in the number of attendants required for a naval vessel. Though there may be some reduction in the work of oiling, this possible reduction is to a great extent counterbalanced by the fact that turbines are unfamiliar machines, and the engineering personnel will not, for years, understand their operation as well as they do that of the reciprocating engine.

Greater Economy.—At the designed speed, that is full speed, marine turbines are about as economical as the best reciprocating engines now being built. When the speed is decreased, the steam consumption of the turbine, per unit of power delivered, increases very rapidly, so that at one-half power and below, it is considerably more than that of the reciprocating engine, and at low powers, several times as great.

To show how this works out in practice, I will take the results of the "Dreadnought's" trial, as taken from the notes published in the November number of the Journal of the American Society of Naval Engineers, and compare these with some results obtained with the U. S. armored cruiser "Maryland" while in service. The engines of the "Maryland" are not up to what is now the best economical design of reciprocating engines; and they were designed about seven years ago. Reciprocating engines fully 10 per cent better in economy are now being built for large naval vessels. The results are taken from service runs with ordinary American coal and with an ordinary crew, made up largely by recruits.

The coal used on the "Dreadnought" was no doubt about the best in the English market, and probably contained 16,000 B.T.U. per pound. The coal used on the "Maryland" averaged about 14,000 B.T.U. per pound. Considering these differences (13.3 per cent in heating value of coal, and the fact that in one case the coal was in a measure at least picked, that a trial crew was used, and that efforts were made to obtain all possible economy to make a good showing for the turbines), an approximation to a fair comparison of results would be to take off 15 per cent from the "Maryland's" coal per I.H.P. and compare this with that of the "Dreadnought." (See last column under table of "Maryland's" performance.)

The boilers of the "Maryland" and of the "Dreadnought" are of the same type, Babcock & Wilcox, so that differences in boilers may well be left out, and the difference in coal per I. H. P. may be attributed to the engine installation.

By comparing the results, it will appear that the "Maryland's" reciprocating engines are, at designed full power, about as economical as the "Dreadnought's" turbines at full power. Below full power, down to ½ power, 22 to 18 knots, the difference is slightly in favor of the reciprocating engine; from ½ to ¼ power there is about 30 per cent in favor of the reciprocating engine; and below ¼ power the reciprocating engine uses 50 per cent and upward less coal.

The best reciprocating engines used in the merchant service are 10 to 20 per cent more economical than the full-speed performance of the "Dreadnought."

Avoidance of Vibration.—This the turbine accomplishes, and in this it has an important point of superiority. The vibrations of the reciprocating engines installed on battleships are, however, now so slight, due to improved balancing, that they offer no serious objection from a military point of view.

"DREADNOUGHT'S" PERFORMANCE.

Power.	I.H.P.	Approx. Speed.	I.H.P. per pound of coal.	Pounds of steam per I.H.P.
1/12	1,748	9.0 knots	4.16	41.6
1/9	2,771	10.8 "	4.97	49.7
1/7	3,423	11.4 "	3.23	32.3
1/4	5,000	13.1 "	2.59	25.9
1/2	11,301	17.3 "	1.99	19.9
3/5	13,748	18.1 "	1.89	18.9
4/5	15,875	19 "	1.66	16.6
4/5	16,950	19.3 "	1.7	17
Full	23,000	21 "	1.51	15.1

"MARYLAND'S" PERFORMANCE.

1/10	2,624	9.5 knots	†2.3	1.95‡
1/8	3,232	11.2 "	2.04	1.734‡
1/8	3,152	12 "	2.3	1.95‡
1/5	5,422	14 "	1.95	1.66‡
1/3	8,444	16 "	1.71	1.45‡
2/5	10,520	17 "	1.74	1.48‡
3/5	15,395	19 "	1.74	1.48‡
Full*	27,101	22.5 "	2.3	1.95‡

The advantage of economy of the turbine in marine work exists at a certain speed, which is the full speed for the turbine; when this speed is lowered, the economy drops rapidly. At ¾ speed and less the best types of reciprocating engines are more economical, and below ½ speed they are twice as economical. If turbines are to be placed in battleships on the ground of economy, they ought to be reasonably economical at the cruising speed. The cruising speed of battleships will be a little above half speed, 11 to 14 knots, 1/5 or 1/4 power. At this speed the turbine will use 50 to 100 per cent more coal per unit of power developed. If it is desired to go full speed, the turbine will show a slight superiority in economy, but hardly over 5 per cent. The question then is: Will this slight increase in economy at top speed be worth the sacrifice in economy of over 50 per cent at the speeds that the vessel will ordinarily run? In those ships where full maximum speed is the essential point of their being, the turbine will have an advantage; but where full speed is not to be used continuously, this advantage disappears. Battleships will not cruise at 20 knots, nor at 18 either. It is too costly, and they do not carry sufficient engineering personnel to maintain such a speed for any length of time.

In view of all this, it seems that the superior advantages of turbines for propelling battleships have not as yet been *conclusively* proven, nor should the Navy Department be considered extremely conservative in not definitely requiring them without alternative for the battleships whose contracts are about to be let. It may be that in time such increased economy will be developed for the turbine at the lower powers that it will remove this serious objection which is now present.

The turbine, however, has a place in naval vessels where its advantages are fully worth while, and that is in vessels that are built primarily for speed and for continuous steaming at full speed. Such vessels are the scout cruisers, torpedo boats, and destroyers. Here the turbine has more of an advantage, and it is here that its merits should be developed.

There is also another field where the turbine is peculiarly applicable, and that is for operating the dynamo engines on board ship. This is a field where a constant speed of revolution is necessary, and where the turbine system should show with advantage its points of superiority. The proper procedure would seem to be to develop the turbine for those places where its advantages are greatest, and not to place this new and apparently popular motor in a place where it has as yet not proven its superiority in an all-round manner.

The Army and Navy Journal says that though England appears to be taking the lead in turbines, she has copied America far more in her types of screw engines than America has copied England. The prevailing types of screw engines first used in the mercantile marine and the navies of both countries are what are known as the "back-action," "direct-action," and the "vertical overhead cylinder" engines; and these types all originated in America. The first ship in the English navy which had her entire steam machinery below the water line, and the first one whose engines were attached directly to the screw shaft, was the "Amphion," the design of whose machinery was made in New York and sent to England.

* On this trial steam was put in receivers, and safety valves were blowing part of the time. When all the steam passes through throttle, 25,000 I. H. P., which is 10 per cent above designed power, can be developed with about 1.8 pound per I. H. P., or with 15 per cent reduction, 1.53. The "Pennsylvania," a sister ship, has developed more than this on trial with an expenditure of 1.83 H. P. per pound of coal.

† Results obtained by dividing total coal used for main engines and all auxiliaries by the I. H. P. of main engines.

‡ I. H. P. per pound of coal after taking off 15 per cent to equalize on account of difference in coal and conditions.

A HARVEST OF THE SEA.

BY W. G. FITZ-GERALD.

From pearls to herrings, the sea yields many harvests; but almost without exception men have to go and get them. There is one yield, however, within

Loading the Carts with Seaweed Previously Collected at Low Tide.

the reach of the very humblest. He may not be endowed with lands, or possess the necessary ability and patience for agriculture, but he can go down to the sea beach without a cent and gather in a bountiful harvest.

It is in the well-known Channel Islands off the British coast that seaweed farming is carried on systematically and scientifically. The "crop" is also cultivated off the coast of Cornwall, and in many countries of Europe—especially where the tremendous Atlantic gales sweep up this valuable commodity in huge banks, all ready for the harvesters. In such places the industry gives employment to hundreds of men and women.

In the islands of Jersey and Guernsey especially, hundreds of tons of seaweed were formerly exported to the mainland of England for fertilizing purposes; but of late years the immense and increasing market gardening industry of the islands themselves has found use for all the seaweed gathered. As much as 3,000 tons may be harvested in a single season, when nearly 60,000 cartloads are removed from the beach. The weed is not only retailed in open market to agriculturists, who value it highly as fertilizer, but it is also largely bought by chemical manufacturers of the islands and mainland, who distill iodine from it.

One finds on inquiry that these regular seaweed "farms" have been in existence for nearly four hundred years, and there are many quaint old laws and customs connected with them. Each seaweed district has its own local council, made up of successful farmers, and these bodies allot to each man his farm. This curious piece of property is merely a stretch of beach, from which the tenant is permitted to gather all the weed that a bountiful sea may cast up.

The farmer, however, is obliged to obey a regular code of by-laws, infringement of which may mean considerable fines. Guernsey especially supports home industries and the first question asked of an applicant for a farm is whether or not he is a resident of the district. If he is not his application is rejected, but if he be willing to settle down in the island and work for its welfare, a plot of arid shingle is allotted to him.

The farm is peculiar in another respect, for the tenant pays no rent whatever, so that his only expenses are those of kilning and harvesting. Each farm is marked out with big bowlders, and may consist of from 400 to 600 yards of beach. All seaweed cast up within this area is the absolute property of the tenant.

A Laden Cart on the Shore.

One of the strictest by-laws is that forbidding a man to gather "varech"—as the weed is called locally—on a Sunday. Very tempting is it to break this rule during a great storm on Saturday night, when vast quantities of the profitable weed are thrown upon the beach, with the absolute certainty that the high tide which comes before Monday morning will take back into the bosom of the sea forever the proffered gift.

There are Biblical laws about the removal of a neighbor's landmarks defining the boundaries of his farm. Such offenses are considered so serious that a man may not only be heavily fined, but also lose his farm absolutely.

The harvest is at its height during the months of July and August. In some regions there is a kind of "close time," and harvesters can only gather the weed during those months. Other districts, however, permit their farmers to take advantage of the vast quantities of "varech" cast up by the winter gales.

The outfit of the seaweed farmer is simple enough. It consists of a few long-handled picks and rakes, a few long knives, some carts and horses, with the necessary laborers. It is worth noting that the carts used to remove the harvest are far smaller than those employed by ordinary agriculturists. This is in order that when fully laden they may not sink their wheels too deeply into the sand or shingle of the shore. Some farmers use special carts with barred sides, so that the sea-water shall drain off from the weed in transit. The draft horses are mere sturdy ponies; and so deep is the road with sand and stones, that one will frequently see a cart laboring along with three and four animals harnessed tandem fashion.

Most of the farmers, by the way, kiln their weed before selling it, but there are many who do not possess a kiln of their own, and sell it in stacks as it stands on the seashore at about \$1.50 a ton. This is a very low price, considering that seaweed is one of the best manures known to agriculturists. It is commonly put on the soil and permitted to rot. Many farmers, however, use only the ashes left in the kiln after the weed has been burnt. These ashes are considered to possess really marvelous properties as fertilizer.

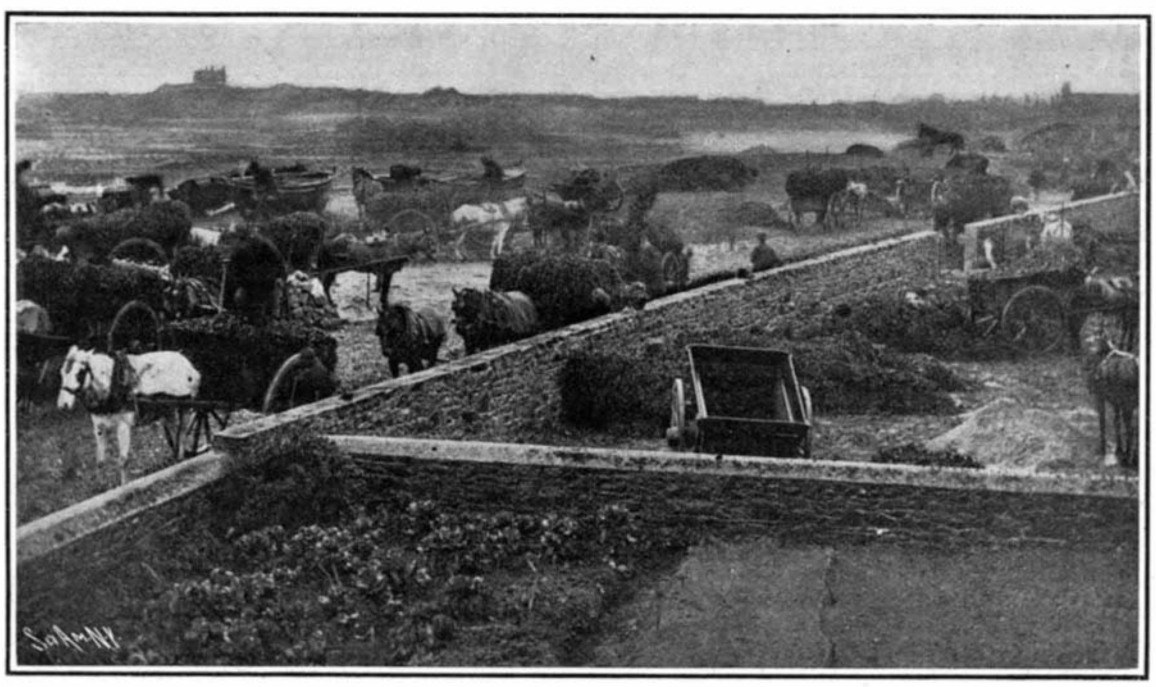
It costs a local farmer about \$100 to build a kiln, but should he be unable to afford that sum, the curious little farm council already mentioned will kiln it for him at certain stated fees, the regulation of which is centuries old. The dry seaweed is thrown into the kiln and set on fire. The draft keeps the stuff smoldering away until it is all consumed, leaving a heap of fine white ash in the receiver below.

Along the coasts of Jersey, Guernsey, Alderney, and Sark, lie vast submerged banks of seaweed quite close to the surface. The banks are occasionally a very serious menace to navigation, particularly when enormous masses of the weed are torn free by the storms. Thus, the great liner "Mohican," which foundered off this coast ten or twelve years ago, owed her destruction entirely to vast entangling masses of floating seaweed, which caused her to drift into the breakers in utter helplessness.

At low tide these banks are visited by the seaweed farmers, and great masses are literally reaped from the sunken rocks by means of sickles attached to long poles. The weed is cut off at the roots and floats to the surface. It is brought ashore in lighters in immense quantities. Oddly enough, its price continues to drop, although the local iodine industry grows steadily year by year.

When the weed is used unburned upon the land, it is plowed into the ground in February and March; otherwise the residue of ashes is scattered over the ground immediately after plowing.

The quaintest sight of all connected with the seaweed harvest is the great procession in May at the conclusion of a successful winter's season. Every seaweed cart appears to be present and the sturdy little ponies are all decked with colored ribbons. Quaintly-dressed men, women, and children are seen forming in procession, and bearing picks, sickles, and rakes which have done duty to such good purpose throughout the season.



Carts Loading and Unloading the Seaweed.

A HARVEST OF THE SEA.

THE MANUFACTURE OF WORSTED CLOTH.

BY W. FRANK M'CLURE.

Introduced into the United States little more than fifty years ago, the industry of making worsted cloth has grown with remarkable rapidity, especially in the last fifteen years. It is to-day by far the most important part of dress goods manufacture. According to the figures of the twelfth census, the annual production of worsted dress goods in this country exceeded 103,000,000 square yards, and that of woolen 41,000,000.

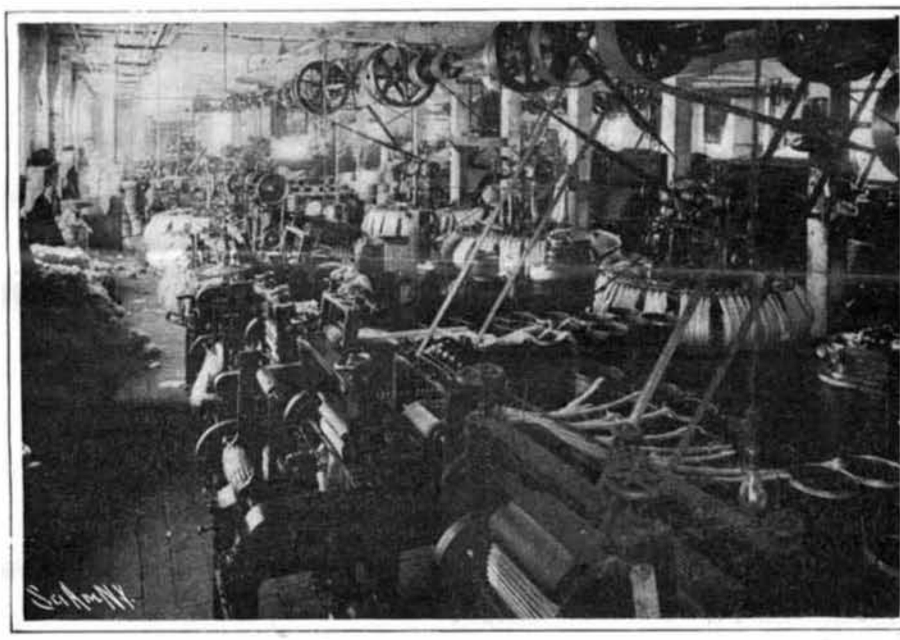
Only the long fibers of wool are used in the making of worsted cloth, while in woolen manufacture the short fibers are utilized. Woolen goods are spun directly from the wool as it comes from the carding machines, while wool for worsted cloth must go through an additional process to straighten out the long fiber. The raw product arrives at the worsted mill in bales of different shapes and sizes, weighing all the way from 200 to 1,000 pounds. As soon as the burlap covering has been removed, the first of the skillful operations, that of sorting, begins. Each fleece is rolled out upon a sloping table, and the sorter proceeds to pick out the best wool first, having in mind at all times the weight, strength, color, fineness, and softness. The loin wool and that on the hind quarters is short and coarse. That on the fore part is most apt to be filled with burs. That about the sides and shoulders has a soundness of fiber, an evenness of length, and a fineness in every way superior to the rest. In some wool the feeding and the shelter that has been afforded are at once apparent. Warm climates are also conducive to distinct kinds of wool, and each kind is best suited to a respective kind of cloth, as are also the respective parts of a single fleece. American wool is the softest, but its goodness is often lost to no small degree because the sheep from which it has been taken has been allowed to roam among thorns and burs which have torn its coat; or, perhaps, a bale of wool may be badly marred by the binding twine which has held it in place, producing a flaw which, if not intercepted, would go clear through the various processes to the finished cloth. Australian wool is prized in great measure for the care which the growers give to these important details.

Wool once sorted is ready to be washed. In one of the accompanying photographs the facilities for wool washing are nicely illustrated. At the factory these are known as "scouring bowls." They much resemble vats and the machinery within a rake with enlongated teeth. The wool is automatically carried from the sorting table into the first of a series of these bowls or vats. As the mechanical washing proceeds the wool moves forward, and every few feet is automatically lifted and fed into a device resembling a wringer, from which it is delivered into the next bowl, and so on until it finally is carried into a large metal inclosure known as a "dryer." In the cleansing operation soap is employed. The amount of soap used in the United States in all the wool industries, both for scouring wool and fulling and cleansing cloth, was 35.136,593 pounds for a recent year.

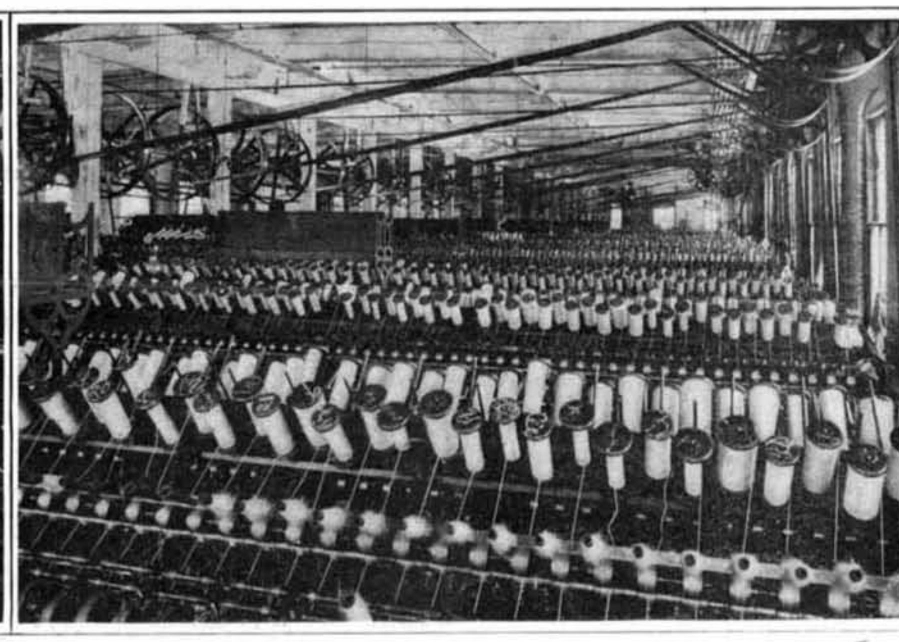
In the dryer the wool travels round and round upon a conveyor, and while so doing is subjected to the heat of steam pipes. As fast as it becomes dry it is delivered by a blast of air that is at all times blowing in the direction of an opening at one side. Since it left the sorting table the wool has lost in weight in animal oil and dirt perhaps 35 per cent. After drying, carding is the next operation. Carding machines were invented

Sorting the Wool.

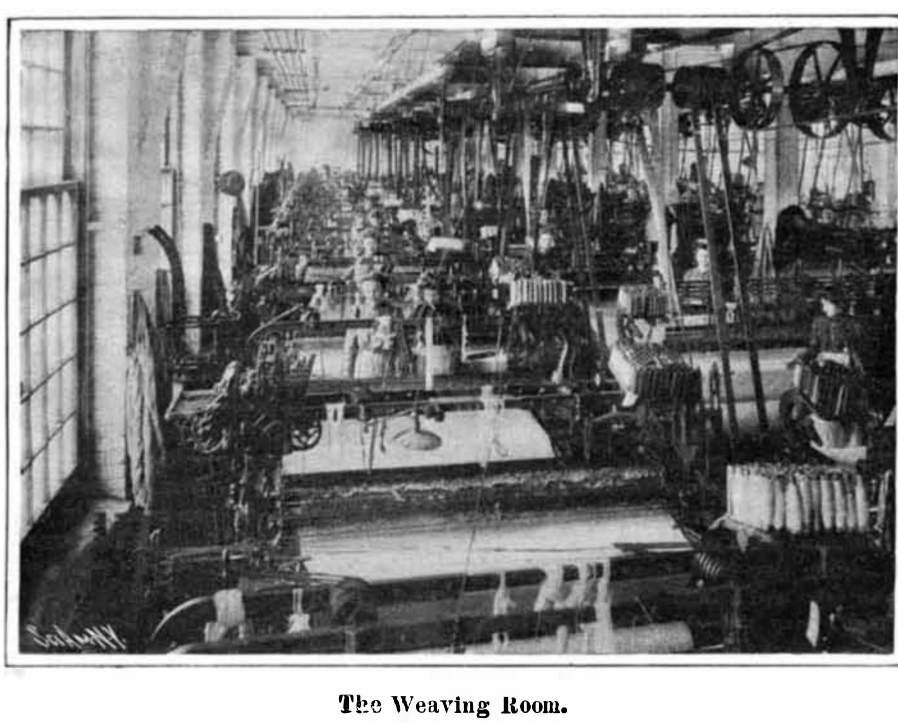
Inspecting Worsted Cloth.



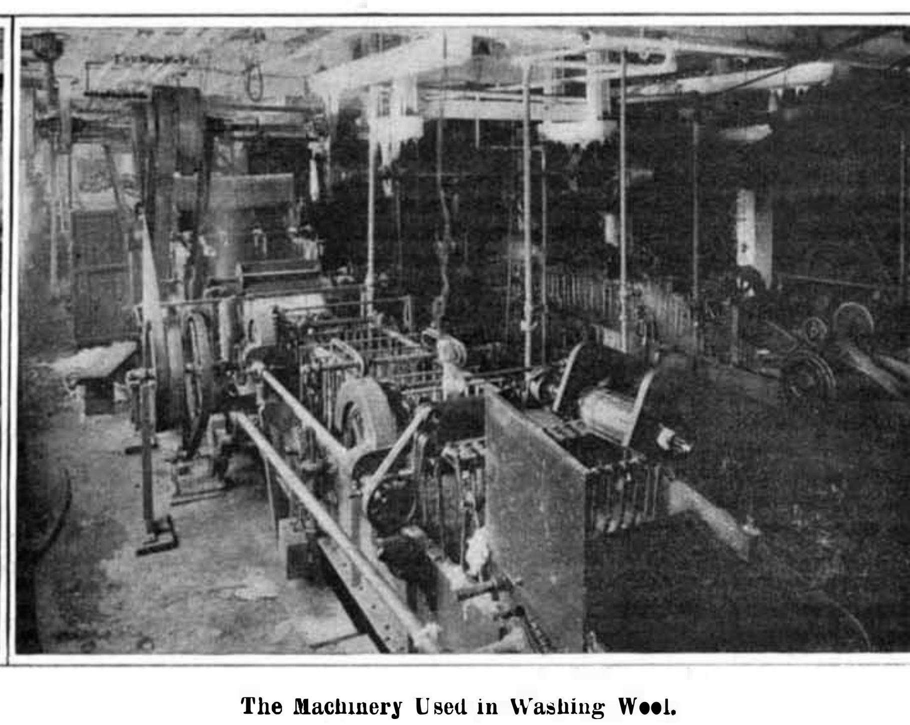
Automatic Combing of the Wool.



A Glimpse of the Spinning Room.



The Weaving Room.



The Machinery Used in Washing Wool.

THE MANUFACTURE OF WORSTED CLOTH.

near the close of the eighteenth century, and with all their subsequent improvements are to-day used, as heretofore inferred, in both the woolen and worsted industries. These machines in the main consist of large cylinders belted with leather, the leather in turn being fitted with fine wire teeth. The teeth on one cylinder are all curved in one direction, and those on another in the opposite direction. When in operation, these cylinders revolve in opposite directions within a fraction of an inch of each other. As the carding machines operate upon the wool, it is pulled into a fine film and wound around the cylinders. Finally this film is automatically gathered from the cylinders and guided until it comes from the machine in a delicate rope of loose fibers. A long antiquated method of carding consisted in drawing the fibers over two oblong boards covered with leather fitted with fine wires. The first carding mill in this country was established at Pittsfield, Mass., in 1790. At first the carding was an industry in itself, and the other departments of woolen manufacture were carried on at other places.

It is at this point in the manufacture that the combing away of the short fiber and the collecting together of the long fibers for modern worsted cloth is introduced. The long fibers are all laid parallel to each other. The machinery for this operation is equipped with thousands of closely-set teeth no larger than pins. An idea of the general appearance of the machines can be gained from the photograph of a combing room. The combed and collected wool is delivered into metal cans in the form of loosely-twisted ropes. In the drawing room these loose ropes are "drawn" out, which means just what the name implies. It goes into one drawing machine as one yard and comes out eight yards, and so on.

The next operation, that of spinning, is one of the oldest industries in the world's history. Fifteen hundred to two thousand years before Christ the spindle and the distaff were known to the people of Egypt. The distaff was a simple stick around which the fiber was coiled, and held in the left hand. The spindle resembled a top set in motion by a twirl of the hand. Two or three thousand years later came the placing of the revolving spindle in a frame where it could be operated by foot power, and in 1763 the spinning jenny—a most important invention, comprising eight spindles—made its appearance. A modern factory to-day operates several thousand spindles in the aggregate.

Spinning is the final operation in the converting of raw fiber into thread. It is a continuation of the drawing process to attain the desired thickness of thread and at the same time twisting the fibers into the firm continuous threads of the strength necessary for the subsequent operations of weaving. In worsted manufacture the threads are then either twisted together with more threads of wool or with threads of silk, this depending upon the quality of the cloth to be made. The thread, before going to the looms, is wound first onto a six-inch spool and then unwound onto larger spools.

Weaving is the passing of one set of threads transversely through another and interlocking them in such manner as to form a united surface. The threads which run lengthwise are known as the warp, and the transverse threads the weft. Part of the threads forming the warp are raised and part depressed, thus leaving a space between. Through this space between the raised and depressed threads of the warp the shuttle carrying the weft is passed. Then by raising the threads which are depressed and lowering those which are raised, the interlocking results. All this was accomplished by hand looms for centuries. What is known as the "power loom" did not make its appearance until the nineteenth century. The power loom to-day automatically raises and lowers the series of threads, and passes the shuttle through the intervening space and likewise the subsequent operation, with all the skill of the human hand. A master mechanic sets the looms for the performance of a certain piece of work, and girls keep the shuttles filled. If in the operation a thread breaks at any point, the loom stops automatically.

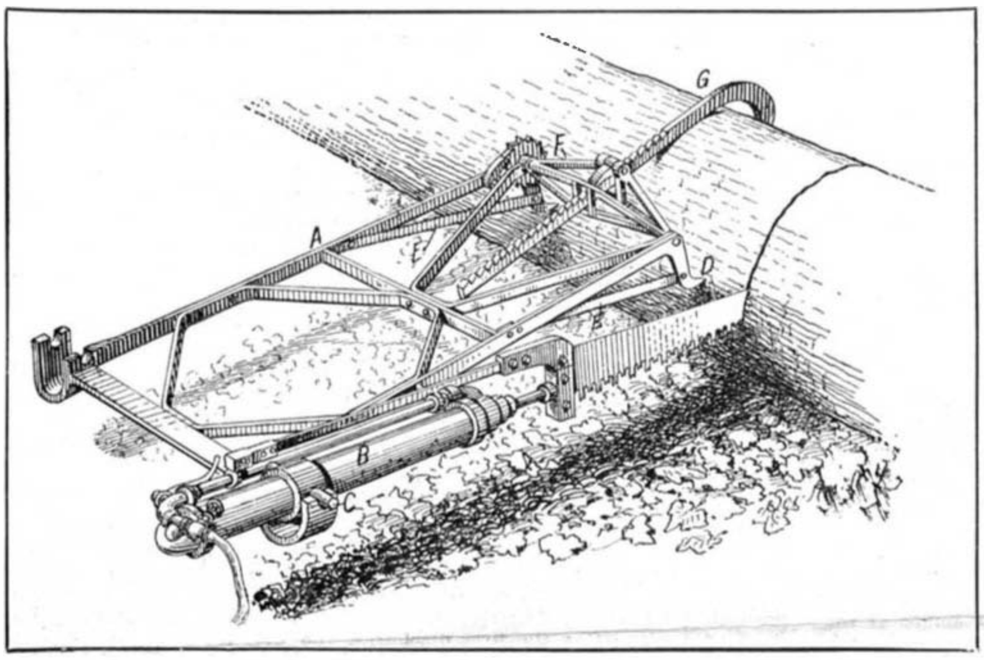
The cloth, after coming from the looms, is still further cleansed, examined, and dyed, The water is then extracted, and the cloth travels over a system of steam pipes. Unevenness is removed by an operation known as "shearing," after which comes the pressing between large rollers. Next it is measured, and wound into rolls.

THE USE OF COMPRESSED AIR IN LOGGING.

BY E. A. STERLING.

Machinery of special design has found extensive use in logging operations, particularly in the forests of the South and West. Logging railroads, donkey engines, steam skidders, and wire rope systems of various kinds contribute to the ease and economy of getting logs to the mills. The primary steps of felling the trees and sawing them into log lengths have, however, been done mainly by hand labor up to the present.

Machine saws of practical value for cutting standing timber have never been perfected, largely because the necessary power has not been available, and also on account of the danger and difficulty of handling a machine of any kind in rough forest land. The same is true in the main of sawing the felled timber into standard logs. An exception to the latter is found on the lands of the McCloud River Lumber Company in Siskiyou County, California, where a compressed-air



The Compressed-Air Saw, Showing the Adjustable Frame and Pivoted Cylinder.

The Compressed-Air Logging Saw in Operation.

THE USE OF COMPRESSED AIR IN LOGGING.

"bucking-up" saw has been successfully used for some years. The trees are felled by hand, and cut into log lengths by the machine saw. The company operates on comparatively level land near the base of Mount Shasta, where the forest of yellow pine, sugar pine, and white fir is composed of unusually large individual trees in open stands. The ground cover is a rather dense chaparral.

The machine consists of a traction engine equipped with an air compressor and a storage tank. To the air tank are attached rubber hose which give a working radius of 300 feet. The saws, which are similar to a heavy cross-cut saw, are actuated by a piston working in a small cylinder set in a movable frame, which can readily be attached to logs of any diameter.

The cylinder, which has pivot trunnions removably hung in bearings, is connected with the compressed-air tank by a line of hose. The usual outfit consists of three frames and one saw. The saw when started is left to work automatically, while the two empty frames are being moved to new cuts and attached to receive the saw. A "swamping" crew precedes the compressed-air saw and trims the felled trees, throwing the brush to one side to give room for the machines. The traction engine is moved under its own power to convenient points, where several trees are within reach of the transmission hose. There is a decided economy both in time and labor in the use of the compressed-air machine. To operate it requires nine men, and the average daily expense, exclusive of repairs, is $25. Its daily capacity is from 125,000 to 140,000 feet board measure, though under exceptionally favorable conditions a cut of 160,000 feet is possible. To secure the same output with hand labor would require from fifteen to seventeen men at a daily wage of $2.50, the average cut per man being from 8,000 to 10,000 feet. This gives a daily saving of $12.50 to $17.50 in favor of the compressed-air saw, on an output of from 125,000 to 140,000 feet board measure of logs. This is ample to cover repairs and give a sustained balance above the interest on the initial investment. There is no apparent reason why a similar machine should not be used in other regions where conditions are favorable.

Making Quartz Glass.

It is announced from the Carnegie Geophysical Laboratory in Washington city that quartz glass can be successfully manufactured, but the authorities of that institution decline to commit themselves as to its feasibility from a commercial viewpoint. The chief value of quartz glass over ordinary glass is found in the fact that it can be heated to a temperature of about 1,000 deg. C. without softening, and its expansion under ordinary heat is so small as to be almost a negligible quality. It also can be heated red hot and plunged into cold water without in the least cracking. It has the distinct property of permitting the passage of ultra-violet light rays, making it remarkably valuable in photographic uses.

Quartz glass has been made in Germany for laboratory uses in the form of tubes, by heating small, clear quartz crystals and sticking them together. The tubes and other vessels made after this manner were rough, patchwork-looking affairs, but served many useful purposes. No way was known by which the substance could be manufactured into glass sheets of any size, by reason of the fact that masses of broken quartz could not be fused together without having the resultant glass full of bubbles. Quartz will liquefy under intense heat, but it will never become soft enough for the air bubbles to escape, the result being that melted quartz is a dirty, porous mass more or less like pumice stone.

At the Carnegie Laboratory many methods were tried before definite, satisfactory results were obtained. If the quartz was intensely heated, free silicon was deposited on the inside of the air bubbles, and the glass was spoiled. The final solution of the problem was found in heating the quartz to the melting point, about 4,000 deg. F., and then subjecting it to an air pressure of between 400 and 500 pounds. After this it was allowed to gradually cool. The air pressure squeezed out the air bubbles, and the result was a solid and clear mass of quartz glass. The plates so far made at the laboratory are only about three by five by half an inch in size. The bubbles are few, not over one-half a millimeter in diameter, and are not frequent enough to interfere with the use of the glass for lenses, mirrors, and other optical work. With more skill and experience the glass can be made without the flaws which confronted the workers.

A novel feature in tunnel design devised by Mr. Charles M. Jacobs, the chief engineer to the Pennsylvania tunnels under the Hudson River, is found in the screw piles, which will be placed at intervals of 15 feet throughout the length of the tunnels. While the silt forming the bed of the river is sufficiently tenacious to hold the tunnels in perfect alignment during construction, it was not considered firm enough to do so when the tunnels are in use. To forestall this possible danger screw piles will be sunk to a solid foundation, and upon them the tunnel proper will rest. The piles will be 27 inches outside diameter, and the shell will be 1¼ inches thick. The sections will be 7 feet in length, and will be bolted together through internal flanges. The lowest section will be cast with one turn of a screw 4 feet 8 inches in diameter.

Correspondence.

Sweet Milk Diet.

To the Editor of the Scientific American:

In the Scientific American of March 2 I read a letter from Clay Harpold relative to a sweet milk diet. He cites several cases of stomach trouble or dyspepsia aggravated by the use of sweet milk which could not be cured until the use of sweet milk was discontinued. For a great many years I have been troubled with dyspepsia or indigestion. I tried several doctors and various patent medicines without relief. I was troubled the most at night; in the daytime not as much. I reasoned that the erect position in the daytime allowed the gases generated in the stomach to escape. If I went to bed without supper, I was not distressed in the least. One evening I made my supper of bread and milk, and I rested as comfortably as if I had eaten nothing. This was a hint which I took. For about four months I have eaten bread and milk at the evening meal without feeling any return of the trouble. Two or three times I have eaten other food as an experiment, and in each case I have been distressed more or less, according to the amount that I had eaten. Thomas Ryan.

Lockport, N. Y., March 11, 1907.

Spike Fastenings on Railroad Curves.

To the Editor of the Scientific American:

In regard to your observations of the New York Central wreck in your issue of March 2, I would like to add a few remarks to the practical side of the question.

In a conversation held with a track foreman who has been for thirty-four years in the employ of the Chicago and Northwestern Railway on their double-track system, he stated that he had taken spikes out on curves *that were nearly worn through* where the base of the rail bears on them; also, that spikes wear more when a rail is placed on a tie plate than when placed directly on the wood. Supposedly a rail placed directly on the wood gives the rail more spring, and the wear covers a larger surface on the spikes.

This foreman said that he used his best oak ties on a curve, and a brace made especially for this purpose by the Chicago and Northwestern Railway, for the sharper curves. This brace fits under the head of the rail, and flares out and is held by three spikes at the outer end.

If the spikes were worn as herein stated in the New York Central wreck, we can readily see why the tests were held afterward (with new spikes) with safety at a speed of 82 miles an hour without any further elevation or alignment of the track.

The position of the center of gravity in the electric motors and the elevation of the outer rail are very good considered scientifically, but do not overlook the spike, the only thing that keeps the rail in its place.

Rockford, Ill., March 11, 1907. L. H. Luther.

An Opinion on the Transmission of Life from Star to Star and on Leduc's Artificial Plants.

To the Editor of the Scientific American:

The letter from C. W. Bennett on the "Transmission of Life from Star to Star" brings up the subject of inorganic cosmical and biological evolution. According to Lockyer and others, very hot bodies are extremely simple in their composition. In the hottest stars like Zeta Puppis, in the constellation of Argus, the spectroscope shows that the elements are few, and most of them in a dissociated or proto form. The most prominent element is hydrogen and proto-hydrogen. The less prominent elements are helium, proto-magnesium, and proto-calcium. In cooler stars, metallic elements appear and the number of elements greatly increase. Since the hotter stars contain fewer elements, it is logical to assume that if the temperature of a star were sufficiently high all elements would be dissociated and all matter reduced to the corpuscular form.

As we descend from the hottest stars down to the coolest visible stars the elements increase in number, but all visible fixed stars are above that critical temperature where chemical action is possible and the elements are therefore uncombined. It is only in colder bodies like the earth that there is the complexity of matter due to chemical combinations, where organic life is possible.

Prof. Arrhenius's theory of the pressure of light seems to be pretty generally established. Accepting the theory that the earth and all the planets are subjected to constant bombardment of corpuscles from the sun and stars, I cannot see how germs of cellular life can be conveyed by them through interstellar space, since that space is but little above absolute zero, a temperature that would destroy all life germs of which we know anything.

The article by Dr. Gradenwitz on "Artificial Plants and Cells" recalls an article which appeared in the Revue Scientifique, Paris, two or three years ago, which ascribed to crystals a certain kind of life. The theory was based on phenomena observed under the microscope during the growth of crystals from a solution. A salt was dissolved until the liquid was saturated; by lowering the temperature a series of very complicated vital phenomena appeared. The crystals could move about and possessed the peculiarity of being able to reproduce themselves, by division, gemination, and endogeny. The struggle for existence went on. When two crystals met the weaker would be absorbed by the stronger. They appeared to be alive.

Von Schron discovered that crystals had diseases, some of which were hereditary. The author proposed the formula, *Omne vivum ex molecula* (all life from the molecule). He ascribed to crystals real spontaneous generation. The growth of Leduc's artificial plants appears to be a confirmation of the theory of molecular life. Perhaps in time we may go a little farther and say, "All life from the corpuscle."

John Candee Dean.

Indianapolis, Ind., March 24.

An Artificial Geyser.

To the Editor of the Scientific American:

The illustration and description of the hydraulic air compression plant in your issue of the 16th prompts me to describe what proved to be an artificial geyser, which was accidentally produced in this city about two years ago.

This section is underlaid by an extensive deposit of soft limestone, which is permeated with fissures, cavities, and underground streams; and the "lime sinks," caused by the caving in of a cavern, are easily drained of the water they usually hold by boring a hole in them to the cavities below. It was necessary to drain a low place in the city, which, after heavy rains, formed a pond of about half an acre area with a depth of about 18 inches. An 8-inch hole was drilled at the edge of the pond, the water being dammed back, and at a depth of ninety feet the drill dropped into a cavity some six or eight feet in depth.

The drill was then withdrawn, the dam opened and the water allowed to enter, which it did with a rapid, whirling motion, not completely filling the pipe. In a few moments the hole began to fill up, violent ebullition began, and the column of water and spray was violently shot up in the air to a height of about 40 feet.

I was on the spot a few minutes after the first discharge and took notes of the action of the well. In six minutes after the first discharge, the well filling again, the discharge was repeated, and the action was continued at intervals of six to ten minutes for half an hour, when, the pond level having been lowered, the intervals became longer and the discharges less violent, and finally ceased with the draining off of all the water. My explanation of the phenomenon was, that the drill had entered one side of a domed cavity having an outlet near the bottom, which outlet was too small to carry off the volume of water entering, and the air carried down by the water was, of course, compressed in the chamber until its high pressure forced out the column of water in the pipe. With very heavy rains furnishing a sufficient volume of water, the action is repeated. C. W. Tift.

Albany, Ga., March 18, 1907.

The Orbit of the Sun and the Solar System.

To the Editor of the Scientific American:

In the issue of February 9 of the Scientific American, J. D. W. C. (Inquiry 10374) asks concerning the probable length in earth years of the orbit of the solar system. I have before me an article by Richard H. Byrd which, I think, answers this question very completely. I quote from the article as follows:

"Our sun through the centuries travels a long ellipse, dragging the world, of course, with it, and just within one end of this ellipse blaze the rays of another sun, known to astronomers as the star Arcturus. At the other end of our sun's ellipse are cold voids, vast spaces of absolute zero.

"Astronomical records are complete enough to show that somewhere more than twenty centuries ago Arcturus was visible only as a luminous speck. Now it blazes in the evening sky, bright as the planet Jupiter, a beacon among the glittering points of fire that stud the firmament this side the Milky Way. Manifestly, our own solar system is approaching the sun Arcturus.

"The rate of travel of our sun through space, carrying with it its little group of satellites, including the world, has been determined with fair accuracy. We are racing southward through the heavens at the rate of about 5,000,000 miles a year, along an arc whose segment shows undeviating progress in the one direction of Arcturus. Eventually, we will be carried clear around this star and be subjected to its fierce rays; then we will come back on the other side of the ellipse, and will be carried along a wide and awful sweep toward the star Polaris, now in our rear, and to the extreme curve that must be passed before the journey back again begins. How many times our solar system has swung that almost illimitable course, none can ever know or guess. But in this great course there are just two extremes of season, except that instead of their being six months, they are about 75,000 years apart. The summer season of this vast cycle is unutterable heat—the melting point; the winter season, frigidity. That we are now a little more than half way down the journey to the summer turning point, and entering upon a spring-like opening to a young summer of celestial weather, is made clear by those whose study is the sky, and to whom the stars present but partial mystery.

"The astronomer Leroy Tobey has shown that the course we are traveling is regulated by the influence of Arcturus, and that it will carry us around that torrid star in something more than 25,000 years. The turn will bring us so near to it, and into a zone of heat so high, that physical life in its present form will be impossible; for Arcturus is an incandescent sun, known to be vastly larger than our own. The belief that the world shall die in fire enwrapped a truth —as all beliefs do when they are understood.

"On the other hand, at the Polaris end of the great ellipse are 'thrilling regions of thick-ribbed ice.' Flung to the extreme limit of its course, before it turns again in answer to the magnet of its orbit, our sun and the worlds that circle it, being farthest from their source of heat, will dim and fall into a sleep of cold so deep that life will be suspended, to again awaken and again begin a new development, as the southward turn is made and warmth flows in once more."

This is only a partial quotation from the article referred to, which appeared in a local publication, but I think is sufficient to answer the inquiry of your correspondent. I do not know where the article first appeared. Elmer E. Towle.

Richmond, Ind., February 18, 1907.

Peary's New Polar Projects.

The Navy Department at Washington has granted another three years' leave of absence to Commander Robert E. Peary, the Arctic explorer, and this added to the fact that orders have been given to hurry along the repair work on the polar ship "Roosevelt," renders it not unlikely that he will have another expedition ready to sail for the north pole by June 10. It is known that he is anxious to get away about that date.

Commander Peary stated in his lectures that if he ever started again to reach the pole he would take a course more to the westward from the last starting point, a thing he learned on his last trip.

There were only two obstacles that he encountered in his plans to try again to reach the goal of his ambition. One of these was the raising of funds to pay the expenses of the expedition, and the other was the necessity of obtaining a leave of absence from the Navy Department. A few days ago the announcement was made that Commander Peary had received a guarantee of $200,000 for a new expedition.

The other obstacle was overcome when the Navy Department granted the three years' leave of absence.

The Current Supplement.

The current Supplement, No. 1633, opens with an excellent article by G. K. Gilbert on the rate of recession of Niagara Falls. A series of pictures made at intervals from 1827 to 1895 show how rapid has been the erosive work of the great cataract, and how the shape of the Falls has changed year by year. The induction coil, however small, should be provided with a switch for making and breaking the primary circuit, and as it is often desirable to change the direction of the current through the inductor, as the primary winding is called, a reversing commutator can be employed to advantage. How such a reversing commutator may readily be constructed at home by the experimental amateur is clearly told by Mr. A. Frederick Collins. Working drawings accompany the text. Dr. Frederick H. Millener contributes a discussion of the pernicious effects of alternating current of high voltage. Mr. Taylor's splendid article on the chemical composition of tool steel is concluded. How coke is made is told very lucidly in an authoritative article. Prof. A. Durig writes on alcohol and mountain climbing. The gigantic increase in the erection of skyscrapers in lower Broadway, New York city, has been made in the face of grave and increasing engineering difficulties which concern chiefly foundation problems. These are excellently discussed by Mr. C. M. Ripley. Mr. J. Percy Moore traces the evolution of the elephant.

Repulse of Balloons by Coast-Defense Batteries.

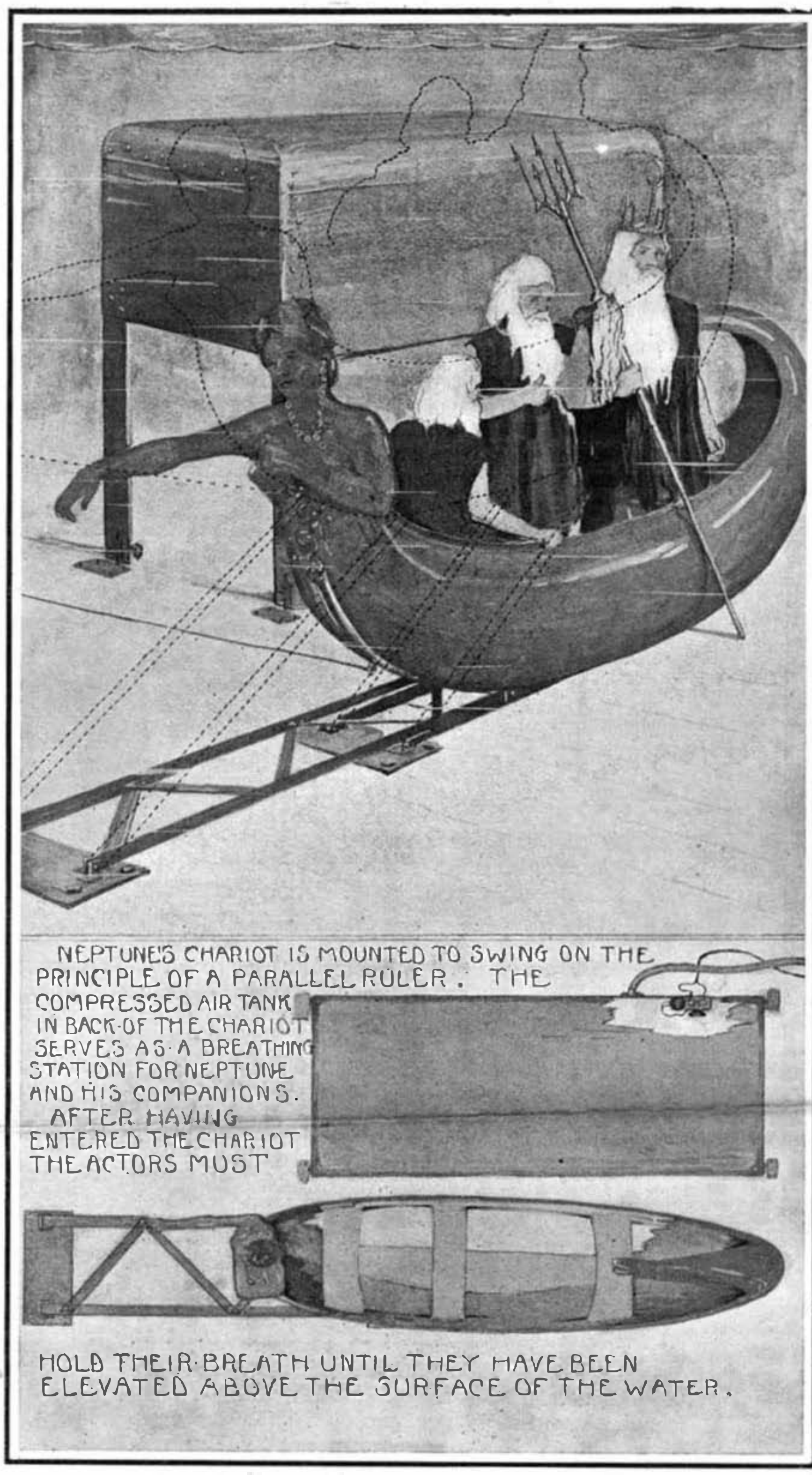
The German military authorities have been conducting a series of interesting experiments at the Heubude coast-defense battery, Danzig Bay, with the object of determining the efficiency of modern ordnance in repelling captive and free balloons. The battery was equipped with 10-centimeter guns and mortars. Shrapnel was the ammunition used. Floating at a height that varied between 18,000 and 25,000 feet, balloons of 100 cubic meters capacity were quite easily brought down. Only one balloon escaped inland.

THE HIPPODROME MYSTERY UNVEILED.

One of the most pleasing and altogether mystifying effects or illusions that it has ever been our pleasure to witness is now being presented on the stage, or rather in the tank of the New York Hippodrome, which is noted for its aquatic spectacles in which the huge, oval tank plays so important a part. In the present instance "Neptune's Daughter," a romantic operatic extravaganza, depends entirely on the great cistern for the now famous mermaid scene. Neglecting for the moment the story, which is not material to our purpose, we may state that when the curtain falls at the beginning of the second scene (for at the Hippodrome the curtain does not rise, but sinks in a well surrounding the tank), we see the fishing village of St. Malo on the coast of Brittany. To the left is the cabin of Marceline, the droll clown. This cabin is an important adjunct in the carrying out of the effect. The whole front of the stage is taken up by the huge tank which is filled with placid water. At the appropriate moment up from the sea rises the beautiful Sirene, the Queen of the Mermaids. She sings of the wonders of the deep and pleads with the hero to plunge beneath the surface of the water and see for himself the marvels in the realm of King Neptune. As he hesitates Sirene summons her mermaids, who rise from the sea and by their singing entice several fishermen to plunge into the water. The fishermen return to the surface and tell wonderful tales of their adventures. The hero follows Sirene beneath the surface of the water and the heroine appeals to King Neptune to restore her lover to her. Neptune in his barge, drawn by mermaids, emerges from the water and promises the heroine that if she will accompany him to the bottom of the sea he will restore to her arms the lost Pierre. She enters Neptune's barge and to the amazement of the villagers the boat with its burden sinks out of sight.

There are three people in Neptune's boat when it emerges from the sea and four when it is engulfed at the close of the act. The mermaids, of whom there are nine in all, gradually arise from the water and appear to stand quite firmly on its surface and accomplish some clever posturing.

It is difficult to call this attraction either an illusion or an effect. In truth it is very real, for the mermaids appear at the surface and dive down at will, and as the tank is known to be of solid concrete without an opening, it is a great puzzle to decide what becomes of the girls in the interim between their actual performances.



The Elevating Device at Rest Just Prior to Raising.

This very clever act is the invention of H. L. Bowdoin, of New York city, who conceived the idea of utilizing the principle of the diving bell. To illustrate the working of this device, take a glass tumbler, and plunge it into the water with the mouth perpendicularly downward. It will be found that very little water will rise in the tumbler, but as air is compressible it could not entirely exclude the water, which by its pressure condensed the air a little. The invention provides means whereby with the aid of a tank of water, drowning, disappearing, rescuing, and other scenes can be effectively rendered. The device can be constructed in a number of ways, using the diving bell principle in all cases.

At the Hippodrome individual diving bells are used. There are six in all, five small individual bells and one large bell for the occupants of Neptune's boat. Prior to the opening of the act the six air bells, which are constructed of boiler plate, and are supported on legs provided with castors, are run on the stage and are rigidly secured to the lid of the tank, which is raised or lowered by powerful hydraulic pistons. The mermaids go on the stage and place their heads within the upper portion of the bells. Each bell is provided with an operator, who raises and lowers a little individual lift secured to the chamber, and who also assists the mermaid in re-entering the air cell. Air hose connections, telephone, and electric light wires are also quickly connected, and at a signal from the stage manager the water in the hydraulic piston is released and the stage drops into the water so that the top of the diving bells are submerged two feet below the surface of the water. Directions to the performers are given by telephone and the actual signals governing their return to the surface are given by red and green electric lights. The air pressure is sufficient to give them ample breathing space while they are compelled to stay below the water. When the signal is given, the mermaid steps into a stirrup on the lift, which is controlled by a small winch operated by the attendant. Two handles, somewhat resembling those of a bicycle, serve to steady the mermaid during her trip in this subaqueous elevator. On reaching the surface she steps off and climbs up on the bottom of the diving bell, which is provided with a small guard rail. She is then at liberty to perform her part of the scene without hindrance. At the

"Neptune's Daughter" as Presented at the New York Hippodrome. The Mermaids Standing on Their Air Bells and Neptune's Chariot in the Rear.

THE MYSTERY OF THE HIPPODROME MERMAIDS UNVEILED.

proper time it is necessary for her to actually plunge into the water and dive for the entrance to the bell. Her attendant quickly draws her into breathing space. Each mermaid is provided with a separate diving chamber and with a separate attendant. The fishermen who dive into the water share with the mermaids their air chambers provided for them, and they come to the surface after they have given the idea that they had actually been to the bottom of the sea. When the hero yields to Sirene's pleadings and dives into the water, he knows exactly where to find his air chamber. A good deal of fun is caused by the clown Marceline, who pretends to fish from the tank and suddenly pulls out a live dog. This is accomplished in a simple manner by providing an air chamber and an attendant for the dog. Marceline's fishing line is attached to the muzzle worn by the dog.

More complicated is the entrance of Neptune, who rises to the surface in a barge 12 feet long. At the proper time Neptune and his fellow passengers leave the large air chamber and seat themselves in the barge, which has the rear part cut out. The barge is then quickly drawn up through the water, and the emergence of this weird craft always produces a great sense of wonder. Our engraving shows the method of raising the barge or chariot, as it might be called in theatrical parlance. The boat rests on parallel bars which resemble a parallel ruler. They are operated by a cable which runs out of the tank in Marceline's hut, where five stage hands wind the cable upon the drum of a winch, thus raising the parallel bars which carry the boat.

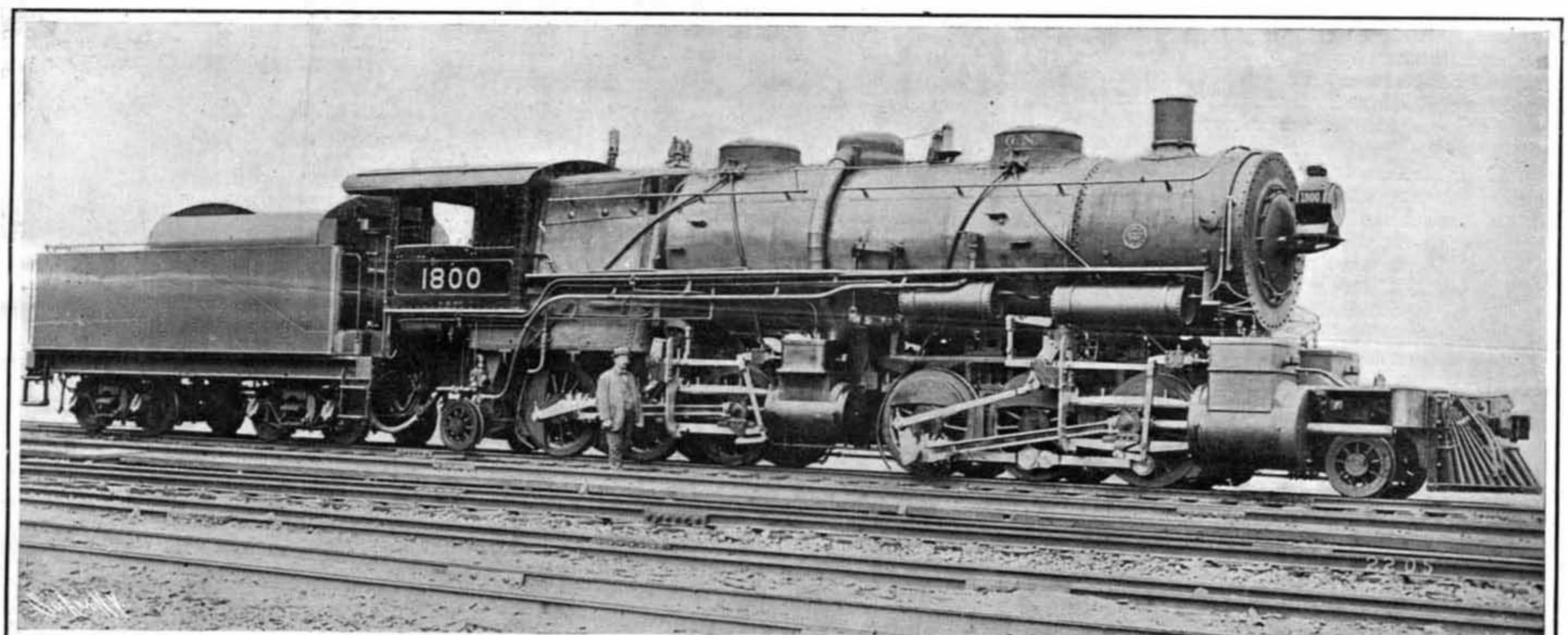
The mermaids are protected from cold by rubber undergarments. Their grease paints are waterproof. Notwithstanding the apparent reality of the effect, many people consider that the whole scene is some sort of a mirage effected with the aid of mirrors. This apparent marvel of modern science is merely an adaptation of an old principle.

A 250-TON MALLET LOCOMOTIVE.

During the late exposition at St. Louis there was exhibited, in the Transportation Building, a Mallet articulated locomotive built for the Baltimore & Ohio Railroad, which was the most powerful built in any country up to that date. During the past two years this locomotive has been doing excellent work on the mountain division of the Baltimore & Ohio, where it has not only proved equal to heavy duty for which it was designed, but has been hauling exceptionally heavy trains on a moderate cost for fuel and repairs. The weight of the engine alone is 334,500 pounds, and its tractive effort, working as a compound, is 71,000 pounds, and working as a simple engine, 86,000 pounds.

The Baltimore & Ohio locomotive has now been exceeded somewhat in weight and power by another design of Mallet freight locomotive, which has been built and delivered by the Baldwin Locomotive Works to the Great Northern Railway. This engine, which is one of five now in course of delivery, weighs 20,500 pounds more than the Baltimore & Ohio engine. It differs from its prototype mainly in the fact that, instead of the whole of the weight being on the twelve drivers, it is provided with a pony truck at the front and a trailer at the rear below the cab. Consequently, although the engine is heavier, the weight on the drivers is less by 18,500 pounds. The steam pressure also is less, being 200 pounds to the square inch as against 230 pounds in the earlier engine; but the total heating surface also is slightly greater, as is also the cylinder capacity.

The Mallet type has for its distinguishing feature two separate engines, each operating its own set of drivers. In the present case the high-pressure cylinders, which are 21.5 inches in diameter by 32 inches stroke, are carried upon the main frame of the engine at about midlength of the boiler, with which the frame is rigidly connected through the saddle and at other bearing points. The six coupled driving wheels are 55 inches in diameter. Steam is admitted to the cylinders through outside steam pipes leading down on the outside of the boiler from the steam dome. The exhaust passes through a flexible joint placed at the vertical axis of the saddle, and passes to a pair of low-pressure cylinders, 33 inches in diameter by 32-inch stroke, which are located at the front end of the radial truck which carries the weight of the forward half of the boiler. From the low-pressure cylinders the steam exhausts to the smokestack through a jointed flexible exhaust pipe. It will be seen that this method of construction provides an engine which, in spite of its great length of 54 feet 7¾ inches, is very flexible, a quality that is rendered necessary by the fact that 10-degree curves are not uncommon on the division where these locomotives will operate. To supply sufficient steam for such powerful engines calls for an exceptionally large boiler. It is of the Belpaire type and is 7 feet in diameter. A tall man could walk through it with a foot of clearance. There are 225 square feet of heating surface in the firebox and 78 square feet of grate area. The total heating surface is 5,658 square feet. Working as a compound engine, this locomotive can exert a pull at the drawbar of 71,600 pounds, and working as a simple engine, by the admission of live steam to the low-pressure cylinders, it can exert the enormous pull of 87,200 pounds.



Tractive effort, working compound, 71,000 pounds; working as simple engine, 86,000 pounds; steam pressure, 200 pounds; high-pressure cylinders, 21.5 inches by 32 inches; low-pressure, 33 inches by 32 inches.

THE NEW 250-TON MALLET COMPOUND LOCOMOTIVE.

Another Test of Alcohol as an Automobile Fuel.

After having shown the possibilities of alcohol as a fuel for automobiles in the long-distance run from New York to Boston last winter, the makers of the Maxwell automobile decided to see what can be done with this fuel under more favorable circumstances. In the first test extremely bad snow-covered roads were traversed, and the pulling power of the engine under these conditions was found to be very good when alcohol was used as a fuel. In the present test, which was conducted by the Automobile Editor of this journal, some of the best and smoothest roads to be found in America were traversed at high speed. The test consisted of a run from Trenton, N. J., to Atlantic City, a stop being made at Philadelphia, Pa.

The only change in the engine using alcohol as fuel was that the compression was increased about 33 1-3 per cent, it being raised from 60 to 80 pounds. It was supposed that this increase in compression would make a considerable increase in efficiency; but the result of the test does not show this to have been the case. In order to get any marked efficiency, a compression of at least 150 or 175 pounds would probably be required, as well as a longer stroke.

In place of the kerosene car used in the first test, Mr. Maxwell this time substituted a car the engine of which was fitted with two carbureters. In one of these kerosene was used, while the other was supplied with gasoline. A mixture of the two fuels was thus used in the engine, the idea being to do away with the excessive carbonization produced by the kerosene alone. The results obtained with this car were quite interesting.

The three cars—alcohol, kerosene-gasoline, and gasoline—weighed respectively 2,560, 2,470, and 2,280 pounds. The total distance registered by the odometer was 106.8 miles. The amount of fuel consumed and the market price of the same was—denatured alcohol, 14½ gallons at 37 cents = $5.36½; kerosene, 3 gallons at 11 cents = 33 cents, + gasoline, 5 gallons at 22 cents = $1.10; and gasoline, 7½ gallons at 22 cents = $1.65. The miles run per gallon of fuel for the three cars in the order named were 7.36, 13.35, and 14.24. This corresponds to a fuel cost per car-mile of $0.0502, $0.0133, and $0.0154, while the cost per ton-mile would be $0.0392, $0.01084, and $0.01354 for the alcohol, kerosene-gasoline, and gasoline cars respectively.

A comparison of these figures with those obtained on the former test shows that the alcohol car did slightly better than before, as this time it made 7.36 miles per gallon instead of 6.13 miles. The miles run per gallon by the gasoline car were raised from 10.1 to 14.24, which increase is due, evidently, to the good roads; so that the increase of a mile per gallon made by the alcohol car cannot be laid to the improvement in efficiency of the engine. The increased compression, however, was beneficial in the way of speed, as this car is capable of developing a speed of 35 miles an hour with ease. The most marked increase in distance traveled per gallon of fuel was that of the kerosene combination car. When run on kerosene alone, in the former test, this car made but 7.4 miles per gallon, while in the present test, using 3 gallons of kerosene and 5 gallons of gasoline, this car averaged 13.35 miles per gallon. A corresponding lowering of the cost of operation is noticeable in the figures. The idea of the inventor is to utilize the heavier oil for trucks and commercial vehicles. The combination kerosene car showed good speed and power, as well as economy, and it will doubtless be possible to work out this plan successfully on commercial vehicles, if the saving in operating cost is found to be worth the complication of having two fuels and two carbureters.

The present test showed that alcohol is fully as suitable for high speed as for slow speed and hard work. The alcohol engine ran perfectly when fed from the regular carbureter, and it could be started on alcohol after it had been standing over an hour. When some manufacturer designs and builds an automobile having a special engine adapted to the use of alcohol, tests such as have just been made will be found most valuable to bring out the difference in efficiency between the alcohol and the gasoline engine. Several years ago, at tests in Vienna upon stationary engines, it was found that alcohol will develop practically as much horse-power, gallon for gallon, as will gasoline (and this notwithstanding the fact that alcohol has only about half as many heat units as has gasoline), provided that the two fuels are used in suitable engines. This result will probably never be attained in an automobile engine, as it is impossible to use such high compression as can be had with a stationary engine.

Norwich has in use 18,000 gas cookers and 18,000 slot gas meters, and this total is not equaled by any other city of the same population—just over 100,000.

LOSS OF THE LARGEST SHIP EVER WRECKED.

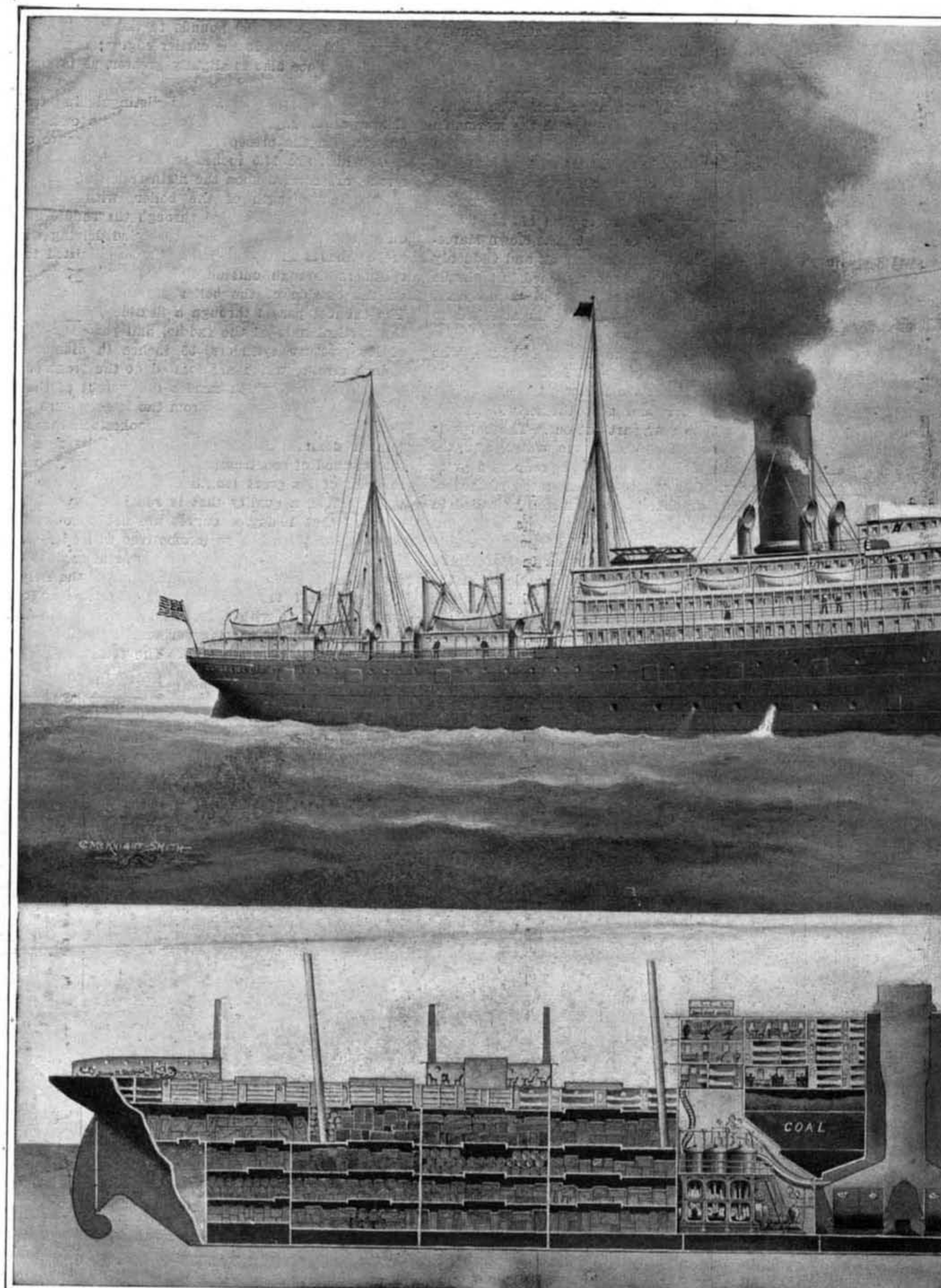
The accompanying photographs, recently received from a correspondent at Yokohama, Japan, show the loss of the largest vessel that ever was wrecked upon the high seas. In respect of the size and value of the ship, this shipwreck is altogether unprecedented; although we are pleased to record that the disaster was free from the usual loss of life, every one of the passengers and crew being taken ashore.

The "Dakota," and the sister ship, the "Minnesota," are both the largest vessels ever built in the United States and the largest that ever flew the national flag. They owe their existence to the energy of Mr. James J. Hill, who built them expressly for the trans-Pacific trade between Seattle, the terminus of the Great Northern road, and the Orient. A curious feature in connection with the construction of these ships is that a new company, known as the Eastern Shipbuilding Company, was formed expressly for the purpose of building them. Moreover, the company took the contract before it possessed the plant, the equipment, or even the ground upon which to build them. A site was ultimately chosen opposite New London, Conn., and here the two huge vessels were constructed, side by side. The dimensions of the "Dakota" are: Length, 630 feet, breadth, 73 feet, and molded depth, 56 feet. On a draft of 33 feet the displacement is about 33,000 tons; and on a maximum draft of 36½ feet, it was claimed that the "Dakota" had a displacement of 37,000 tons, which placed her within a few hundred tons of the maximum displacement of the White Star liners "Cedric" and "Celtic," the largest ships of that day, which measured 700 feet by 75 feet. It is the greater depth and fuller model of the "Dakota" and "Minnesota" which bring their displacement so close to that of the longer and broader White Star boats.

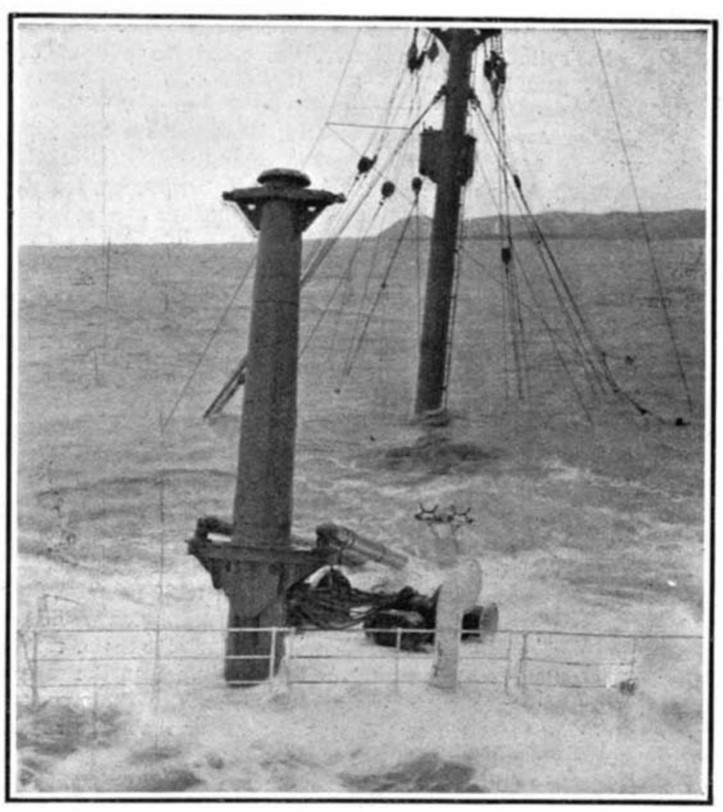
The accompanying drawing, representing the vessel at sea, and the inboard profile which gives an excellent idea of the internal arrangements of the vessel, show that the "Dakota" was in every respect thoroughly up to the best modern practice. Indeed, she was, in some respects, ahead of it; for new methods of construction were adopted in the "Dakota" which rendered her considerably stiffer and stronger than any vessels built for the American merchant marine. The outer plating of the ship's bottom was of 1¼-inch steel, and the shell plating was strengthened by an additional strake of 1-inch plating at the main and upper decks; also continuous 1-inch stringer plates were worked from stem to stern along these two decks as a stiffening to the regular deck plating, which, on the main deck, was 16/20 of an inch in thickness, and on the upper deck 18/20 of an inch. Furthermore, the ship was strengthened against hogging and sagging strains by a continuous central longitudinal bulkhead reaching from keel to upper deck. This was the first case of the use of an absolutely unbroken longitudinal bulkhead in a vessel. Then again the vessel received great longitudinal strength from the use of a new system of stanchions and girders. Instead of the use of a large number of pipe or tube stanchions, there were three lines of heavy box-section columns, measuring 13 x 24 inches and spaced 20 feet apart. The deck loads were carried on continuous lines of 13 x 24-inch box girders to which the box stanchions were riveted. This arrangement, it will be seen, is not only economical in distribution of material, but adds greatly to the longitudinal stiffness.

The stiffness of these vessels was also enhanced by their great plated depth of 56 feet. From the outer bottom to the navigating bridge there are no less than eleven distinct decks or platforms. First there are the outer bottom; the inner bottom; the orlop; lower; between; main; and upper decks; all of these decks are of steel plating and are contained within the molded structure, 56 feet in height, of the hull. Above the upper deck are the promenade; the upper promenade, and the boat decks, the last-named being 81½ feet above the keel. The "Dakota" had accommodations for 150 first-class, 100 second-class, 100 third-class, and 1,000 steerage passengers. There were also quarters for the accommodation of 1,200 troops, and the ship could carry 20,000 tons of cargo.

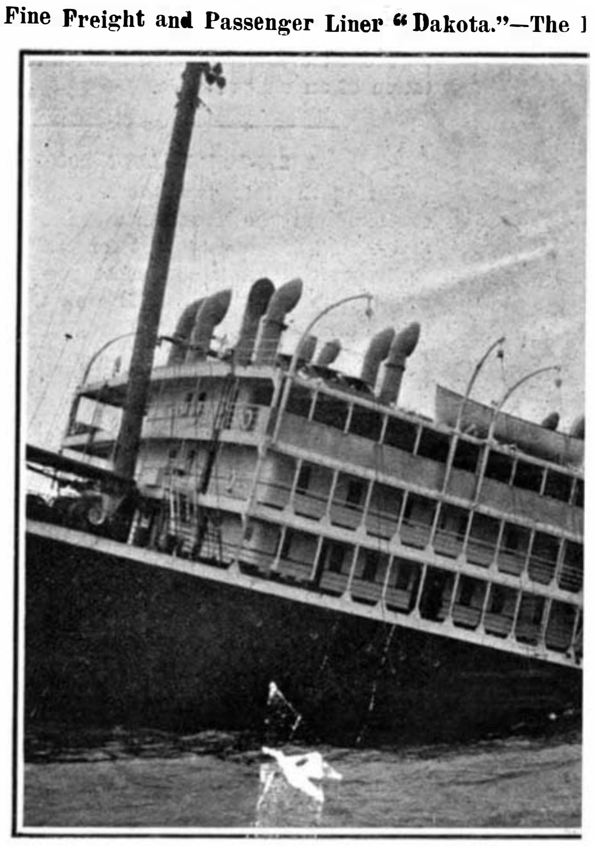
The disaster to the "Dakota" occurred on Sunday evening, March 3 last, when she ran on a submerged reef while she was about five hours' steaming from Yokohama. Either the blow must have been a terrific one, opening a huge rent in the vessel, or else the watertight doors must have been open; for the "Dakota" was of such great size, and was built with such ample watertight provisions, that she should have been capable of being kept afloat, or at least on a fairly even keel, even after striking as heavily as she did. Whatever be the cause, the ship very speedily filled, and sank into the position shown in the accompanying photographs. The vessel evidently is hung up on the reef at a point abaft of the center, with the result that her bow is buried up to the bridge, and, in spite of her great draft of over 30 feet, the rudder and propellers are lifted clear of the water.



The Fine Freight and Passenger Liner "Dakota."—The I

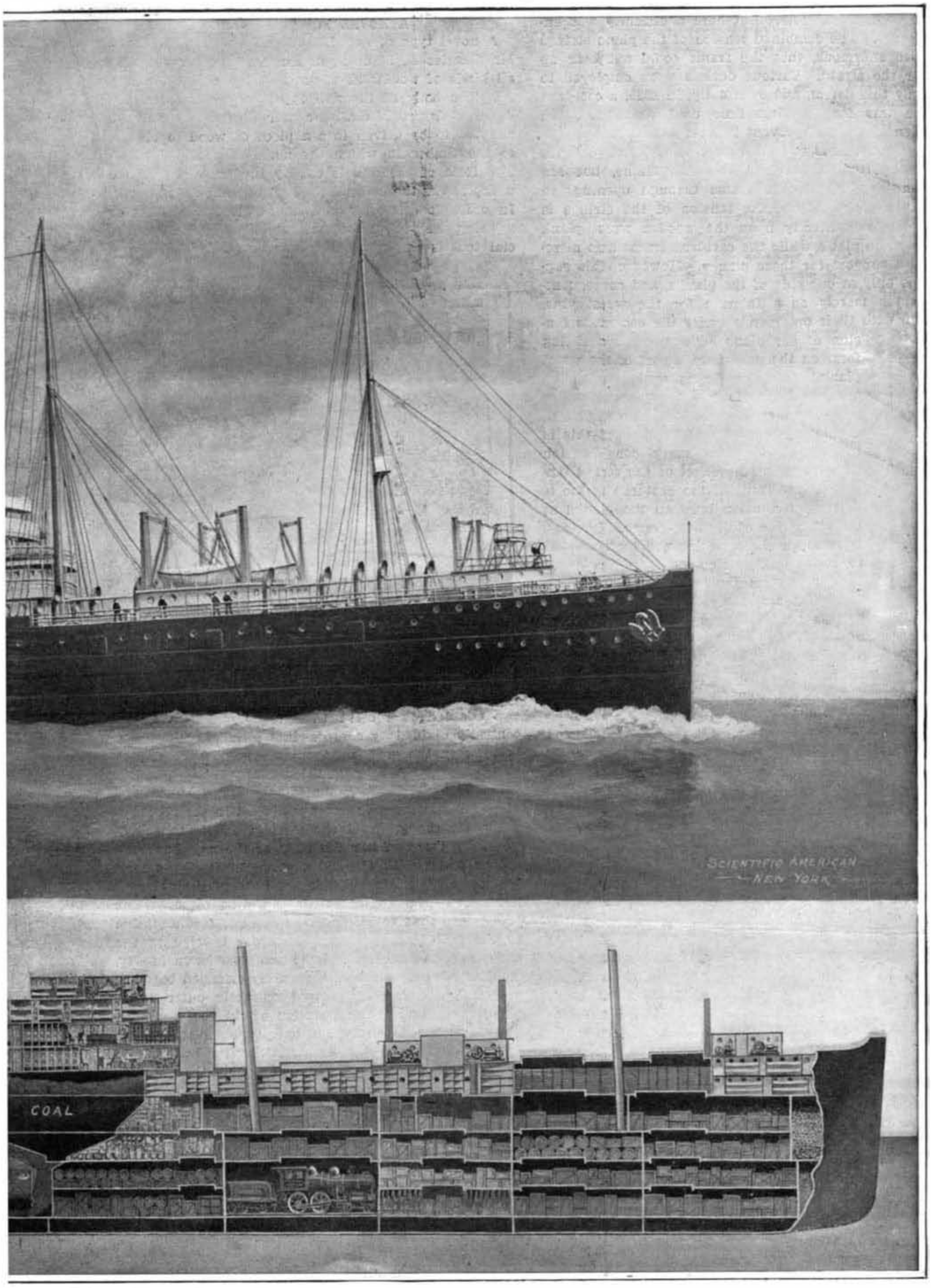


View from Promenade Deck, Showing Submerged Bow.

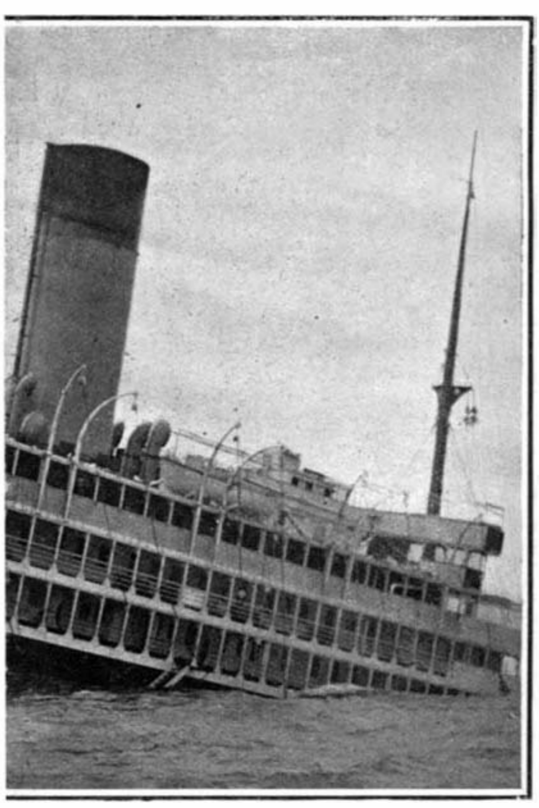


The 33,000-Ton "Dakota" on the Rocks

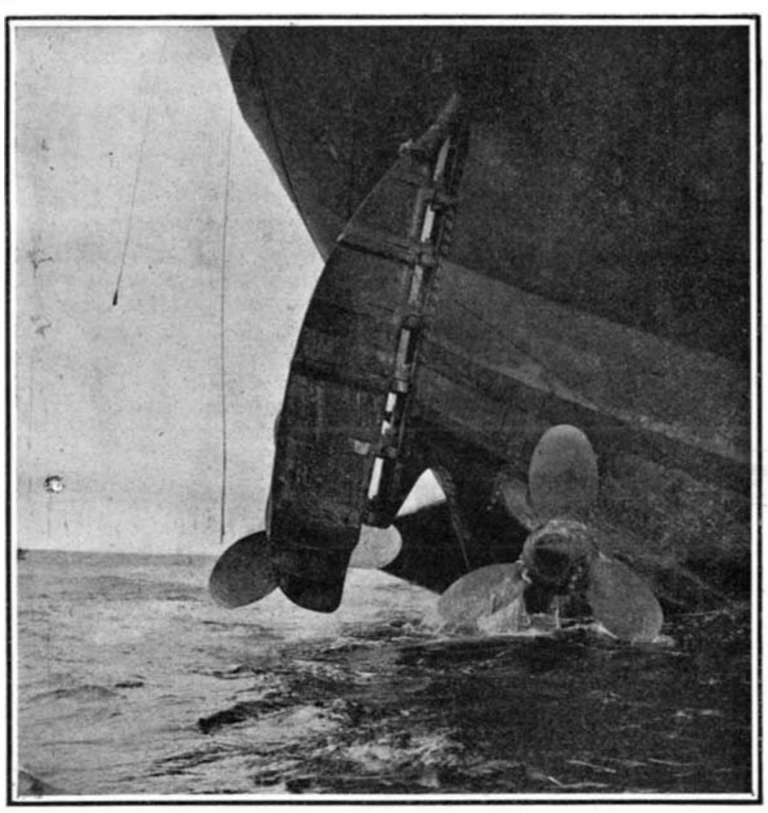
WRECK OF THE LARGEST SHIP EVER LOST



Largest Ship Built or Sailed Under the American Flag.



Near Tokio, Japan. View Amidships.



Propellers and Rudder Raised Clear of the Water.

IN THE HISTORY OF STEAM NAVIGATION.

The photograph, showing the partially submerged foremast and derrick of the ship, was taken by our correspondent from the promenade deck below the main bridge, and it gives a fairly accurate idea of the list to starboard. Looking right ahead through the rigging, one can see the Nogima lighthouse, which is built on the headland which forms the extreme point at the entrance to Tokio Bay. After the ship struck, she swung in toward the land, and consequently this photograph gives no idea of the way she was heading at the time of the disaster. Another photograph was taken from off the starboard side of the "Dakota," and shows the acute angle at which she lies. The third view, also taken from the starboard side, shows the propellers and the massive rudder entirely clear of the water.

The magnitude of this disaster, as affecting American shipping interests, is not understood by the American public. Not only is 20,000 tons gross register swept from the list of our deep-sea shipping engaged in foreign trade, but Mr. Hill has announced that he has no intention of replacing the vessel. Consequently, the gap which is thus opened will probably be filled by some Japanese line, and another serious setback will be suffered by the American merchant marine.

Aldehyde in Cheese.

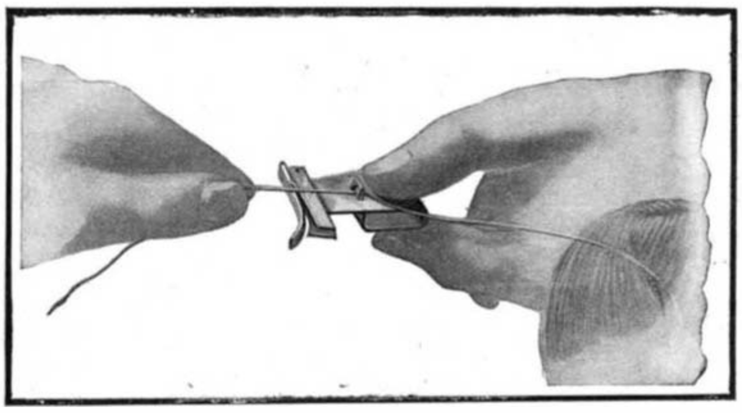
Messrs. Trillat and Sauton, in a paper presented to the Académie des Sciences, describe their researches as to the presence of aldehyde in cheese and its action in giving a bitter taste. They found recently that the presence of ammonia and aldehydes in abnormal quantities in wines was capable of giving them a bitter taste even when greatly diluted, and advanced the hypothesis that the bitterness of diseased wines was due to the formation of an aldehyde resin. By analogy, they wished to see whether such resin was not the cause of an exaggerated bitterness of certain cheeses. They were able to show the presence, hitherto unobserved, of aldehydes in cheese. The operating method is as follows: Mixing 200 parts of cheese in the same amount of distilled water, it is introduced into a flask and has added 20 parts of a 1-10 sulphuric acid solution. Some 50 parts of the liquid are distilled over with proper precautions. The aldehyde is estimated by the color method with rosaniline. Fresh curds show no aldehyde, while different cheeses have varying amounts. It is to be noticed that the strongest amount is found in the cheeses which have a somewhat bitter taste. Owing to the absence of aldehydes in the curds and its presence in matured cheese, they may be considered as products of fermentation. The authors observed also the direct action of aldehydes upon cheeses and sought to produce the bitter taste artificially. Pieces of cheese are placed under a large bell jar in which is vaporized a few drops of acetic aldehyde, representing about 1-100,000 of the air volume. After a few hours the cheeses thus exposed take a yellow tint which becomes stronger and toward the end at the same time as the bitter taste develops. The phenomenon commences at the surface and then gains the central portions of the cheese. Carefully observing the development of the coloration and the bitterness, it is found that it is produced at first in the most alkaline specimens. Fresh curds, under the same conditions, give no color and do not become bitter. Comparative experiments show that the coloration and the appearance of the bitter taste are distinct, and that the presence of oxygen can hasten the coloring without increasing the bitterness. This is shown by exposing pieces of different cheeses to the action of acetic aldehyde vapors under two bell-jars of the same dimensions with and without air. To resume, the authors show the presence of aldehyde in cheese and demonstrate the relation between its presence and the appearance of the bitter taste. They also point the analogy which seems to exist between the rôle of aldehyde in the aging of wines and the ripening of cheeses.

How to Find the Time With a Handless Watch.

Some time ago a poor old peasant who had invoked the king's wrath was seized by the king's soldiers and placed in a dungeon. His Majesty was present, and had the old man searched before being incarcerated. All his personal property consisted of a cheap watch, a small penknife, a shilling in cash, and a lead pencil. The poor old man begged for mercy, but his pleading availed him nothing, and he finally asked to be granted the privilege of knowing the length of his sentence. In reply the king took his knife and watch, which lay on the table, and after taking the knife and prying the hands off the watch, returned to him his watch, saying, "When you have learned to tell the time correctly by this watch in your dungeon cell, you will be liberated." The poor old man, knowing that the king meant a life sentence, staggered into his cell and wept bitterly. Nevertheless, he was liberated in twenty-four hours, having accomplished the wonderful task of telling the correct time in the dark with a watch without hands. How did he do it?

AN IMPROVED TWINE CUTTER.

A recent patent describes a very simple device which is adapted to be carried at the free end of a ball of twine and may be used for cutting the twine when it is desired to sever a length from the ball. The device is provided with a simple clamp by which it is held fast to the twine, thus preventing accidental separation therefrom. However, the clamp may be easily operated to release the twine when it is desired to pass a fresh length therethrough or remove it entirely from the ball. The accompanying engraving illustrates the twine cutter. It consists of a sheet-metal body of T-shape. The forward edge of the T-head is bent downward and is partly cut free of the rest of the head. The free end is bent outwardly and forms a guard for a knife blade, which is secured to the under side of the T-head. A pair of tabs projecting from the rear of the T-head are bent under and against the knife blade, to hold it in place. At the opposite end the sheet metal body is reversely bent upon itself to form a spring finger-piece, the extremity of which is reduced in width and passes upward through a slot in the main body. This extremity is bent upon itself and is formed with an aperture through which the twine is passed and which is normally drawn by the spring finger-piece below the upper surface of the body, thus pinching the twine and clamping it fast. In use when it is desired to sever a length of twine the spring finger piece is pressed to release the twine, and the latter is drawn through the aperture until the required length extends beyond the knife blade. The spring finger-piece is then released to again clamp the twine, after which the twine is cut by drawing it between the guard and the knife blade. The inventors of this novel twine cutter are Messrs. G. R. Patterson and W. E. Moen, of 3918 South 16th Street, Red Jacket, Mich.



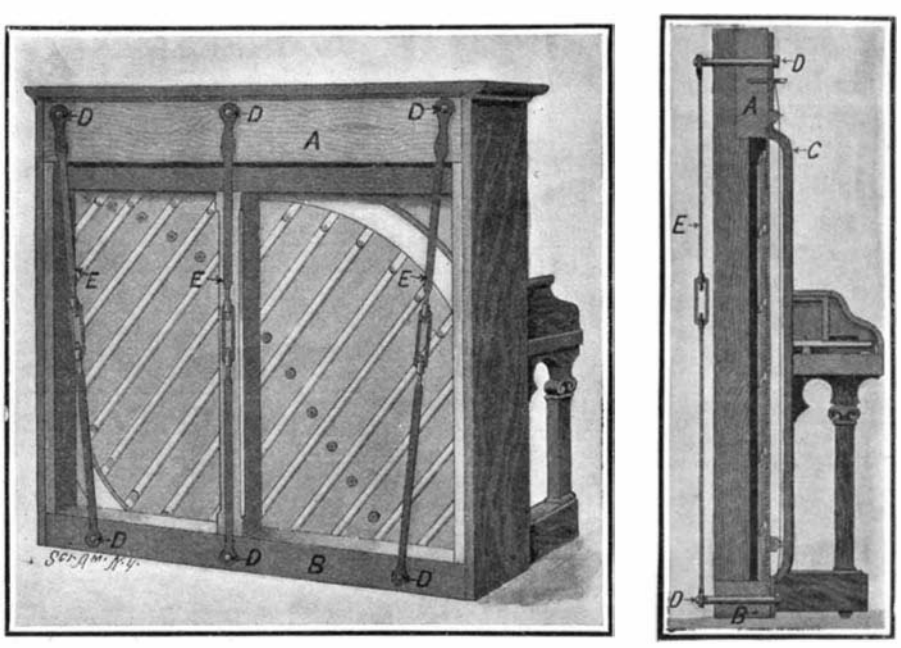
AN IMPROVED TWINE CUTTER.

ADJUSTABLE TENSION RODS FOR PIANOS.

To the compositions of Beethoven we owe the first improvements which raised the piano from its humble position as a modified clavichord to the present highly-developed instrument. In order to keep up with the pace set by the great composer, manufacturers found it necessary to increase the compass and the power of the piano. The sounding board was improved, the range was lengthened, heavier wires were used, and more strings per note. But here a difficulty was encountered. The combined tension of the piano strings was so enormous, that the frame could not bear up under the strain. Various devices were employed to remedy this defect, and eventually, in 1825, a cast-iron frame was for the first time used to support the wooden frame and prevent it from crushing.

This practice is still in vogue. The wrest pins are not supported directly by the iron frame, but are driven into the wooden frame through openings in the iron plate. Hence the tension of the strings is still imposed directly upon the wooden wrest plank and bottom plank, while the cast-iron frame acts merely as a support for these planks. However, this support is only at one side of the planks, and consequently serves merely as a fulcrum for the wrest pins, which, with their outer ends under the enormous tension of the piano strings, exert a lifting force on the unsupported part of the wrest plank. In most pianos made to-day the wooden frame is braced by a series of posts glued to the wrest and bottom planks, composed of end wood pieces; but this is inadequate, as a moment's consideration will show, for the effect of the string tension at the front of the cast-iron frame is to exert a tension between the planks at the other side of the iron frame. Obviously, wooden posts, which are best adapted to resist compression, will not suffice to counteract this tension. What is needed then is a series of tension members, and this is provided by the recent invention of Mr. T. J. Howard, of Toronto, Canada, who has assigned his patent rights to the Newcombe Piano Company, Limited, of the same city. The accompanying engraving illustrates the Newcombe construction. The wrest plank shown at *A* and the bottom plank at *B* are supported by upright posts at each end, and also by a center post mortised into the top and bottom planks; in itself an improvement on the old method of gluing end wood pieces. The cast-iron plate indicated at *C* acts in the usual manner to brace the wooden frame against the tension of the strings, whose lower ends are looped over studs on the iron plate, and whose upper ends are secured to pins driven into the wrest plank. The cast-iron plate is secured to the wooden frame by means of tie bolts *D*, which pass through the bottom and wrest planks. To the rear ends of the tie bolts the tension members *E* are secured. These consist of steel straps arranged in pairs of opposite members, respectively connected to the top and bottom tie bolts. The adjacent ends of each pair are threaded and connected by means of a turnbuckle. The turnbuckle may be adjusted to exert sufficient tension on the top and bottom planks, to counteract the tension of the strings.

Owing to the short leverage on which the piano strings exert their tension, it may at first seem as if the use of tension rods were an unnecessary precaution. But this is far from being the case, as experience has shown. For example, the total pull of the bass strings on a standard Newcombe piano is 7,980 pounds, while the treble strings exert a tension of 30,246 pounds. The combined pull resolved in the vertical direction amounts to 37,080 pounds, or 18½ tons. It has been calculated that with a piano back 7 inches deep, the leverage is sufficient to produce a strain of 3,075 pounds on the tension rods, and by using three tension rods of ⅜-inch diameter, this strain is satisfactorily withstood, or by using heavier tension rods, the depth of the piano back can be safely reduced. In the new construction the usual heavy posts at the back of the piano are dispensed with, giving a more open and efficient soundboard. As the wooden frame is kept in shape by the tension rods, the soundboard will also retain its crown or convex form, thus preserving the tone of the piano. It will be noted that the invention is not a radical breaking away from recognized principles of piano building, but an extension of a principle already used in many ways, where extra strength or resistance is needed.

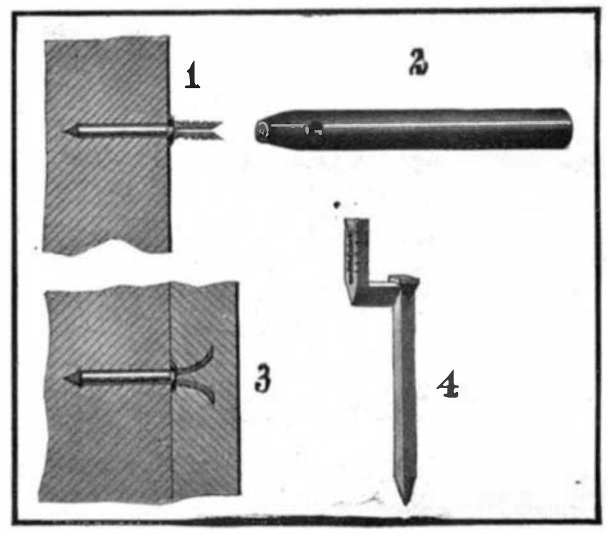


ADJUSTABLE TENSION RODS FOR PIANOS.

Polishing Paste.—Melt together 2 parts of paraffine and 6 parts of lubricating oil; then mingle with 8 parts of infusorial earth 1 part of oleic acid and a few drops of oil of mirbane are to be added.

A NOVEL FORM OF NAIL.

A novel type of nail has recently been invented by Mr. Charles A. Birdsall, of Holden, Mo., for use with all kinds of woodwork where a smooth finish is desired. The body of the nail is of the usual form, but the head is provided with a pair of prongs which are adapted to be driven into a piece of wood to bind it to the timber in which the main body is imbedded. The form of the nail is clearly illustrated in Fig. 1, which shows the body of the nail driven into a timber. In order to drive the nail home without bending or injuring the prongs that project from the head, a special tool is employed, which is illustrated in Fig. 2.

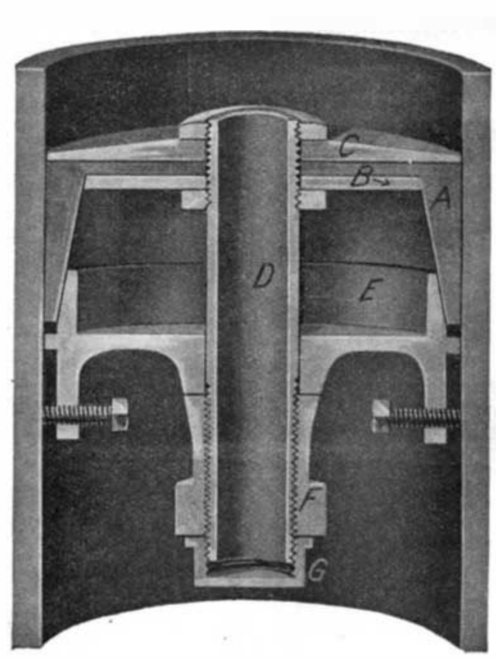


A NOVEL FORM OF NAIL.

This consists of a punch formed with a recess in one end adapted to receive the prongs. This recess is centrally divided by a cross-plate which is adapted to fit between the prongs. A transverse aperture in the punch communicates with this recess, enabling the latter to be kept clean and also serving to indicate to the workman when the prongs are set in the right position for the grain of the wood which is to be engaged by them. After the body of the nail has been driven home with the aid of the punch, the second piece of timber is applied to the head of the nail and hammered into contact with the first piece. The prongs are thus forced into the second piece and, due to the fact that they are outwardly beveled at the ends, they spread apart to the position shown in Fig. 3. The two pieces are thus securely clenched together and the prongs, being scored on their outer faces, positively prevent the separation of the parts. Fig. 4 illustrates a modified form of nail, in which the prongs extend from an offset, thus permitting the body of the nail to be driven into the timber without the use of a special tool to hold the prongs.

PIPE STOPPER OR TEST PLUG.

The accompanying engraving illustrates a device for temporarily stopping or closing soil pipes and the like, to permit of testing them. The plug is so designed as to insure an absolutely tight closure, and yet permit it to be quickly applied to or removed from the pipe when desired. A rubber cup *A* is used, which is braced by a pair of clamping plates, *B* and *C*, lying on opposite sides of the bottom of the cup. The cup is mounted on a tubular stem *D*, being secured thereto by means of jam-nuts threaded onto the stem and bearing against the opposite clamping plates. It will be observed that the inner side walls of the cup are tapered, and co-acting with them is a correspondingly tapered expander *E*. The latter is loosely mounted on



PIPE STOPPER OR TEST PLUG.

the stem, but is adapted to be driven home by means of an operating nut *F* that is threaded upon the stem. The expander is provided with lugs at each side, which carry setscrews adapted to be screwed into engagement with the pipe after the expander has been adjusted to proper position. A cap *G* serves to close the end of the tubular stem. In applying the plug to a pipe, the cup *A* is first inserted, after which the expander is mounted on the stem and, by operating the nut *F*, forced into the cup, causing the latter to engage the walls of the pipe so firmly as not only to insure a hermetic connection, but also to avoid the possibility of the cup being thrown out of the pipe by the pressure therein. The setscrews will then serve merely as an additional precaution against dislodgment. To aid in centering the expander when it is introduced into the cup, a flange is formed on its periphery which lightly engages the inner walls of the pipe. A patent on this test plug has just been granted to Mr. A. Redenbaugh, of Brown Street and Allegheny Avenue, Allegheny, Pa.

Brief Notes Concerning Inventions.

A new type of rifle sight and wind gage has been brought before the British military authorities. It is the invention of the Australian government architect, and is already in use in Australia. With this appliance greater certainty in marksmanship can be assured. With the existing system of sighting, in the excitement of firing the marksman is liable to move on his vernier scale either more or less divisions than his commanding officer instructs, with the result that his shot becomes useless. With this new appliance, however, every time the soldier moves the governing screw of his scale to mark one "vernier," a slight click is emitted by the sight, thereby indicating that the scale has been moved, a similar click being made for every revolution of the screw corresponding to one division of the scale. When the sight clicks as the result of a turn of the screw, it becomes locked and cannot be moved until the marksman alters the screw. Thus on the command "two to right" or "four to left," the soldier turns the screw in the required direction until he has heard the sight click twice or four times as the case may be. Moreover, the soldier can always tell immediately when his rifle is upright, as the "ladder" sight in this device is always vertical. In allowing for wind force, too, the marksman need not twist his rifle in the slightest. Instead, by turning the screw the ladder containing the V sight is moved until the "barleycorn" at the end of the gun barrel is in the correct position. One feature of the device is that it can be easily and quickly removed when desired, its removal rendering the rifle useless, while the sight is not liable to damage when on the march, being carried in a small case in the pocket. The efficacy of the instrument, and its influence upon more accurate shooting, have been strikingly demonstrated by the results of the Victorian Rifle Association, whose aggregates since the adoption of the sight have been higher than before.

When the Prince of Wales visited a block of artisans' tenements that had been erected by the municipal authorities of one of the London boroughs, he suggested that an immense advantage might be bestowed upon the tenants by designing a range the fire in which could serve for either or both of two adjacent rooms, thereby dispensing with the necessity and expense of maintaining two fires, which is at present incurred, the range being requisite for the cooking of the meals and the other for the living room. The Prince's suggestion was accepted by the architect, Mr. C. S. Joseph, who has now succeeded in designing a double fireplace especially for the equipment of such dwellings for the laboring classes. The invention is of a simple character. In the division wall separating the living room from the kitchen one flue is placed, and the fire grate comprises two combined grates, the one being of the ordinary open type for the living room, and the other a closed range for cooking and heating purposes. The combined grate is divided by a shutter which slides up and down in the center between the two sections of the grate. If a fire is desired only in the range or open grate the shutter is lowered, thereby shutting off the unrequired section; if the fire is required in both rooms, then the shutter is left open. Should the fire be required only in the open grate, the shutter is raised upon the completion of cooking. By a simple movement the fire burning in the range can be discharged into the required open grate, and the dividing shutter again lowered. The arrangement for operating the shutter is simple, and can be easily manipulated from either of the two rooms. The successful embodiment of the royal idea has resulted in still another useful boon for tenants. The stove has been provided with a small boiler, by means of which a supply of hot water can always be maintained, whether the fire is burning in the open grate or range. This enables each tenant to have a bath fitted with both hot and cold water in his own tenement, instead of using the facilities for this purpose that are provided in one quarter of the building for all the tenants. For economizing space the bath has been provided with a portable cover, so that it may be used as a table. The invention has been greatly appreciated by the tenants of the buildings, and it will be generally adopted for all future tenements.

A new type of telegraph receiver has been devised by Mr. Ernest Oldenburg, a well-known English electrical engineer, the most noticeable feature of which is its extreme sensitiveness, the faint impulses of a pocket battery being easily detected. This receiver, to which the name "capilliform" has been given, is based upon the capillary action of mercury in a vertical tube under the influence of electric impulses, on somewhat similar lines to the capillary receiver employed in the Orling-Armstrong system of low-tension wireless telegraphy. The influence of an electric current upon the surface tension of mercury, and consequently the form of its meniscus, has long been known, and the success of the "capilliform" receiver as devised by Mr. Oldenburg depends upon the ingenious methods he has adopted for magnifying the impulses, and contriving the device in such a way that it can be utilized as the receiving instrument of an ordinary telegraphic installation. It is anticipated that the instrument will be of great utility for those phases of work where a delicately sensitive receiver is required, more especially in connection with submarine and etheric telegraphy, since it responds to far fainter currents than any appliance at present in vogue, a small fraction of a volt being quite sufficient to operate the instrument. Moreover, the complete apparatus is confined within such small limits that it can be carried in the pocket.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

SAFETY-PIN.—R. DOUGLAS, New York, N. Y. One purpose in this invention is to provide a construction of safety-pin whereby the device may be turned end for end, taking the material from the pin or thrust member thereof onto its body member, thereby preventing the device from leaving the material even should the pin or stick member leave the head of the device, since when the latter is reversed it cannot be withdrawn unless returned to its initial position.

HOSE-SUPPORTER.—L. C. STUKENBORG, Browns, Ala. One of the objects of this improvement is the provision of means to support the hose at diametrically opposite points, especially avoiding the use of metal or other parts that would be uncomfortable to the wearer. It keeps the sock smooth and tight around the leg, ankle, and foot.

Of Interest to Farmers.

MUD KNIFE AND SHIELD FOR HARVESTER-WHEELS.—W. D. TAYLOR, Hartford, Kan. The invention consists of a knife-blade disposed adjacent to the edge of the wheel-tread and parallel to the vertical plane of the wheel and a shield projecting laterally from the knife to prevent mud, straw, or trash being carried upwardly by the wheel and also to prevent these materials being carried above the knife and deposited on the driving mechanism of the harvester.

COMBINATION INCUBATOR AND BROODER.—VERONICA HARTNETT, Sutton, Neb. In the operation of this invention when the chicks commence to hatch the brooder is placed in position on the incubator and the chicks as hatched removed thereto, thus utilizing all the waste heat from the lamp in warming the brooder. The heating pipes are arranged above the egg-trays, and in the brooder the heating-pipes are above the chicks. Space between the walls of the boiler provides a dead-air space, thus diminishing the loss of heat by radiation from the boiler-walls.

GRANARY.—E. G. WARE, Emporia, Kan. The object here is to produce a granary, which is formed of a plurality of matched parts which may be quickly assembled to form the complete structure or disconnected if the structure is to be moved to another place. While the granary is in its nature portable, a further object of the invention is to construct the parts so that it may readily have its capacity adapted to the particular requirements under which it is to be used.

Of General Interest.

RANGE-FINDER.—H. C. PERCY, Natchitoches, La. This patentee employs in connection with a sighting telescope means for computing the sides of a triangle having a known base line. This consists of a triangular frame having a base line adapted to be brought into coincidence with the known base line, the sides of the triangle being movable into positions corresponding to those of the triangle with respect to the known base line. In connection with the frame there is provided a bar for computing east or west departures, the bar being arranged parallel to the base line with its center in line perpendicular to the center of the base line; graduations each side of center indicating east and west departures.

ILLUMINABLE SPECULUM.—R. H. WAPPLER, New York, N. Y. The invention is more particularly employed for examining cavities in various parts of the human body. It relates to means whereby focal range of the cystoscope is modified in such manner that the particular length of the tube used for the sight barrel may be varied to suit different conditions and whereby the clearness of the image brought to view is greatly increased.

FENCE-POST AND SOCKET THEREFOR.—W. L. WELCH, Jamaica, N. Y. The post proper is particularly intended and adapted for use for attachment and support of clothes-lines, and the latter may be conveniently secured to or hung upon the cross-bar of the post proper. It is an improvement in that class in which the post proper is supported in a metal or other socket fixed in the ground by cement or otherwise.

CLOSURE FOR BOTTLES, ETC.—J. W. HULL, San Antonio, Texas. The object in this case is to produce a simple, cheap, and efficient closure which can be readily applied to the bottle and which cannot be removed without evidence of such fact. Owing to the ductibility of the metals used and the different relative thickness of the edge and body of the stopper, the stoppers can be readily locked into the groove in the bottle-neck and form a hermetic seal at that point.

WELL-BUCKET.—J. F. HOLMAN, Neosho, Mo. A drilled well-bucket is employed of special construction at each of its ends, by which the same is prevented from encountering any part or parts of the joints between the superposed sections of the lining of a well either in lowering the bucket within or elevating the same from the well. It is constructed entirely of a single piece of metal or other suitable material, and formed to work in a well without hindrance or obstruction to its movements up or down.

STEP-LADDER.—H. B. FORBES, Ogden, Utah. The invention consists of novel sheet-metal brackets forming the union between the ladder-steps and its front legs, combined with a sheet-metal bracket for connecting the upper ends of the legs with the top board, also affording means to which the rear legs of the latter are pivoted. The front and rear legs are adjustably connected together by strips, adapting the legs to be folded when not in use.

CALENDAR-CHART.—J. B. LINDSEY, Lockwood, Mo. The purpose of the invention is to provide a calendar device or chart so arranged that the number of days from a given date to any other date in the past or future and maturity dates can be readily and expeditiously found and accurately read in days. Twelve charts or leaves are provided and attached to the board in such manner that they may be removed when desired.

WINDOW.—S. U. BARR, New York, N. Y. In the present invention the object of the patentee is the provision of a new and improved window which is simple and compact in construction, completely air-tight and dust-proof, and arranged to permit the convenient opening or closing of the sash. By the arrangement of the packing warping of the sash is avoided.

ATTACHMENT FOR HORSESHOES.—J. W. BUCK, New York, N. Y. Mr. Buck's improvement relates to an attachment for horseshoes, the principal objects thereof being to provide means for preventing slipping, said means being attachable over an ordinary horseshoe, and to provide means for securing it properly in position and adjusting it upon the hoof of the horse.

Heating and Lighting.

BURNER.—P. MISCHKE, East Rutherford, N. J. The object of the invention is to provide a burner arranged to prevent the undesirable backflash, especially when lighting the burner, and to insure a proper mixture of the gas and air, and hence the production of a powerful flame. It relates to gas-stoves, incandescent gas-burners, and like devices in which a mixture of gas and air is burned.

Household Utilities.

DEVICE FOR SUPPORTING FOWLS.—H. M. VANDERBILT, Suffern, N. Y. One object of the inventor is to provide simple means to support in an elevated position a fowl with its breast down during the roasting period, thereby admitting of the uniform circulation of heat about it and its retention in a convenient shape, also to make provision for the adjustment of the device, enabling it to be used for fowls of varying sizes.

COMBINED SINK, BATH, AND WASH TUB.—W. J. MINNS, New York, N. Y. The purpose here is to provide a structure especially adapted for use in a small flat, tenement, or apartment house where there is little available room for necessary single plumbing and wherein in a single article will be combined a sink, a bath, and a wash tub, each adaptation being as perfect and as convenient for use as a series of equivalent independent devices.

DOUBLE-ACTING WINDOW-SHADE. — M. ECKER, Boston, Mass. The object of the invention is to produce a construction and arrangement of parts which will enable the shade to be quickly moved into any position before a window and to enable the shade to cover any portion of a window, extending upwardly from the bottom or downward from the top.

BEATER OR MIXER.—E. J. SCHUIRMANN and T. R. SCHUIRMANN, Chenoa, Ill. In this patent the invention has reference to machines capable of use as egg-beaters, cake-beaters, cream-whippers, or churns, and the object of the invention is to provide a device wherein all of the operating parts, save the crank, are completely inclosed during the operation of the device.

Machines and Mechanical Devices.

MACHINE FOR CORING AND SLICING FRUIT.—P. HANSEN, Jersey City, N. J. One purpose in this case is to provide a machine for simultaneously coring and slicing apples in such manner as to be rapidly and cleanly accomplished and so that the slices will be of uniform thickness. Another is to provide a machine in which the operations will be automatically done and so timed that there is no danger of mishap to the fruit and so that but one attendant, a feeder, is required.

ROCK-DRILL.—F. E. GLAZE, Victor, Col. The drill is more particularly intended for use in boring or drilling rock. The object had in view is to provide or construct boring and drilling tools with means rendering them self-cleaning—that is, adapting them for removal of the dust and chippings during operation thereof.

MECHANISM FOR OPERATING AWNINGS.—W. O. CALMAR, San Francisco, Cal. The object in this instance is to provide a simple construction for locking the gearing to hold the awning in any desired position. The device is applicable either on the right or left side. Ratchets and other devices are dispensed with, and the spring-pressed block entering the crank-aperture from the inside locks the gearing in the simplest manner.

Prime Movers and Their Accessories.

AUTOMATIC CLUTCH-COUPLING FOR SHAFTS.—J. F. THOMAS, New London, Wis. The invention pertains to shafting; and the object is to produce a coupling adapted to be placed in driving-shafting which will be ineffective when the driving-shaft is rotating at low speed, but which will come into operation automatically when the speed is sufficiently increased.

Pertaining to Recreation.

PUZZLE.—C. C. HAYHURST, Barberton, Ohio. The invention relates to puzzles in which one or more balls and devious runs or pathways are employed for conducting the balls from a starting-point to a goal. The object is to provide a puzzle which is simple in construction and arranged to require considerable skill on

the part of the player to solve the puzzle in a comparatively short time.

HUNTING OR SHOOTING GARMENT.—F. Petmecky, Austin, Texas. The inventor provides a coat, sweater, or like hunting or shooting garment for the use of hunters, marksmen, and other persons and arranged to take up and absorb the recoil of the gun, rifle, or like firearm and to form a cushion for protecting the user's shoulders against abrasion when carrying the firearm over the shoulder.

Pertaining to Vehicles.

TRUCK.—A. Schafer and G. Wanee, Red Bluff, Cal. In the present patent the invention has reference to trucks, more particularly handtrucks, and has for its object the provision of a novel construction permitting the truck to be wheeled up and down stairs or steps, as well as on a plane surface.

BICYCLE-PUMP.—A. Genelly and B. Gilberti, Los Banos, Cal. This pump is adapted for inflating bicycle-tires, and an object of the improvement is to incorporate a pump in the frame of the bicycle, so that the pump will always be convenient for use and readily accessible and will obviate the necessity of carrying a separate pump, which would be liable to be mislaid or lost.

WHIFFLETREE-HOOK.—O. B. Haga, Dogden, N. D. This invention refers to improvements in hooks for attaching harness-traces to whiffletrees, the object being to provide a device so constructed that the cockeye of a trace may be readily engaged therewith or detached therefrom, but cannot be accidentally detached.

BICYCLE.—T. Swinbank, Senath, Mo. The invention relates to bicycles. The object of the inventor is to produce a bicycle having improved driving mechanism which will enable the driving forces to be advantageously applied to the driving mechanism. Advantageous means are provided for diminishing the vertical "gear," and applying the brake in this bicycle.

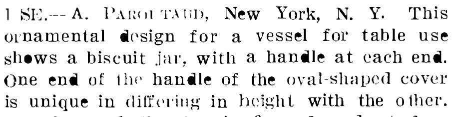
Designs.

DESIGN FOR A VESSEL FOR TABLE USE.—A. Paroutaud, New York, N. Y. This ornamental design for a vessel for table use shows a biscuit jar, with a handle at each end. One end of the handle of the oval-shaped cover is unique in differing in height with the other. The base of the jar is flanged and at four points gives slight indications of feet. Mr. Paroutaud has invented another design for a vessel for table use, a chocolate pot. It is somewhat elongated in height and its base, cover, and bandle have almost the same characteristic sweep of lines that mark and give grace to the jar mentioned above.

DESIGN FOR A BADGE.—A. H. Kopetschny, Jersey City, N. J. This ornamental design for a badge comprises a crescent and a bastioned tower. The latter has a key-hole-shaped window and door, and is clasped by the crescent at its sides, the base of the tower resting down on the inner circle edge of the crescent.

DESIGN FOR RIBBON.—G. A. Morgan, New York, N. Y. Two groups of picture cards of the four denominations in playing cards, then four aces, and then the two groups again, are gracefully placed along the ribbon in this ornamental design. The various groups spread out in fan-shape in opposing directions. Small scroll work runs principally back of the aces.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.



HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(10504) R. L. M. asks how to make transferring varnish. A. Mastic in tears, 6½ ounces; resin, 12½ ounces; pale Venice turpentine, 25 ounces; sandarac, 25 ounces; alcohol, 5 pints. Dissolve in a clean bottle or can in a warm place, frequently shaking it. When the gum is dissolved strain it through a lawn sieve and it is fit for use.

(10505) G. N. O. asks how to make gravel and tar walks. A. Take 2 parts very dry lime rubbish and 1 part coal ashes, also very dry, and both sifted fine. In a dry place, on a dry day, mix them, and leave a hole in the middle of the heap as bricklayers do when making mortar. Into this pour boiling hot coal tar, mix, and when as stiff as mortar put in 3 inches thick where the walk is to be; the ground should be dry and beaten smooth; sprinkle over it coarse sand. When cold, pass a light roller over it; in a few days the walk will be solid and waterproof.

(10506) B. B. S. asks how to make glycerine of cucumber. A. White castile soap, ½ ounce; pommade de concombre, 1 ounce; rose water, 30 fluid ounces; glycerine, 2 fluid ounces. Cut the soap small and dissolve it in about 4 ounces of the water. Melt the pomade and put it in a hot mortar. Gradually add the hot soap solution, stirring until thoroughly mixed, then slowly add the rest of the rose water mixed with the glycerine. Keep well stirred until cool, then let stand for some hours, stirring occasionally. Properly manipulated, a perfect emulsion is obtained. When completed it may be perfumed as desired. The soap employed should be of good quality.

(10507) W. H. asks how to clean ink rollers. A. 1. Rollers should not be washed immediately after use, as they will become dry and skinny, but they may be washed one-half hour before using again. In cleaning a new roller, a little oil rubbed over it will loosen the ink, and it should be scraped clean with the back of a knife; it should be cleaned this way for about a week, when lye may be used. New rollers are often spoiled by washing too soon with lye. 2. To renew a hard roller.—Wash carefully with lye, then apply a thin layer of molasses. Let it stand all night, then wash with water, and let it hang until dry enough to use.

(10508) R. L. M. asks for a varnish for gun barrels. A. To make a good varnish for gun barrels, take: Shellac, 1½ ounce; dragon's blood, 3 drachms; rectified spirit, 1 quart. Apply after the barrels are browned.

(10509) W. P. G. asks how to make a pot pourri. A. Spread thinly the fresh collected flowers on porous paper placed in shallow trays, and expose them to the sun or warm air until sufficiently dry, then lightly crumple them up small between the hands, and the other dry odorous ingredients being added, with or without a little essential oil of the same kind as the dried flowers, thoroughly mix the whole together. Sometimes essential oils only are added to the dry flowers, but the fragrance of the product is then much less durable. As the basis of his finest dry pot pourri, the Continental perfumer usually substitutes either reindeer moss or ragged hoary evernia, in very coarse powder, for the dried flowers.

(10510) M. G. W. asks how to make printers' rollers. A. 1. Take an equal quantity of good glue and concentrated glycerine; soften the former by soaking in cold water, then melt it over the water bath, gradually adding the glycerine. Continue the heat until the excess of water has been driven off, meantime constantly stirring. Cast in brass or bronze molds well oiled. 2. To 8 pounds transparent glue add enough water to cover it; let it stand with occasional stirring seven or eight hours. After twenty-four hours, all the water should be absorbed. Heat in a water bath, as glue is always heated as soon as melted, and when both rise, remove from fire, and add 7 pounds molasses that has been made quite hot. Heat with frequent stirring for half an hour. The molds should be clean and greased. Pour into molds after it has cooled a little, and allow to stand eight or ten hours in winter, longer in summer. Some use far more molasses, three to four times above quantity, and less water. In this case, after soaking one to one and a half hours, the glue is left on a board overnight, and then melted with addition of no more water, and three or four times its weight of molasses added. Two hours' cooking is recommended in this case. 3. Resin soap and small quantities of oil and earthy matters are occasionally introduced. The heating must be continued until the greater part of the water has been expelled, when the composition is ready for casting in copper molds, oiled and warmed.

NEW BOOKS, ETC.

The Engineering Index. Vol. IV. Five Years, 1901-1905. Edited by Henry Harrison Suplee, B.Sc., and J. H. Cuntz, C.E., M.E., in co-operation with Charles Buxton Going, Ph.B. New York: The Engineering Magazine, 1906. Large 8vo.; pp. 1,234. Price, $7.50.

The fourth volume of the Engineering Index represents the continuation of the work originally started by the late Prof. J. B. Johnson in the Journal of the Association of Engineering Societies in 1884, and turned over by that association to the Engineering Magazine at the close of 1895. The previous volumes, published respectively in 1893, 1896, and 1901, met with increasing fullness and thoroughness the field of technical engineering periodical literature; and in the present volume every care has been taken to maintain and advance the standard set by its predecessors. The classification is substantially the same as that introduced in Vol. III. The use of cross-reference entries has been extended, so that every facility is afforded in the search for any article. This volume contains more than 50,000 entries as against 40,000 for Vol. III. The comprehensive extent of the index may be understood, when it is mentioned that the list of periodicals indexed covers 250 technical and engineering journals in six different languages, one-fourth of these being languages other than English. Much of the value of the index is due to the fact that it is a guide to the vast amount of information otherwise practically buried in the numerous files of engineering publications in the reference libraries of the world.

Electrons, or the Nature and Properties of Negative Electricity. By Sir Oliver Lodge, F.R.S. London: George Bell & Sons. 8vo.; cloth; 230 pages. Price, $2 net.

Anything published over Sir Oliver Lodge's name is by nature authoritative, so the treatise under discussion should be given a place in all scientific libraries without delay. It covers the field of matter and electricity, as viewed in the light of the recent discoveries in radioactivity and the kindred phenomena; from the experimental, as well as from the purely theoretical standpoint. Whenever it is possible the methods used to arrive at conclusions are described in detail, making the book useful as a laboratory guide to the experimenter, as well as indispensable to those who are following the theory alone.

Qualitative Analysis as a Laboratory Basis for the Study of General Inorganic Chemistry. By William Conger Morgan. 8vo.; cloth; 351 pages. Price, $1.90 net.

A very excellent work on qualitative analysis, embodying as it does both a description of the various compounds and their constituent elements, with a system of analysis possessing many refinements of methods. Directions for making up reagents and tables of great convenience complete the work.

Metallurgy of Cast Iron. A Complete Exposition of the Processes Involved in its Treatment Chemically and Physically from the Blast Furnace Through the Foundry to the Testing Machine. A Practical Compilation of Original Research. By Thomas D. West. Cleveland, O.: The Imperial Press, The Cleveland Printing Company. 1906. Eleventh edition; 12mo.; cloth; 594 pages, 153 illustrations. $3 postpaid.

It is hard to conceive of a more important subject than the one treated of by Mr. West in his book. With iron so extensively used, there is scarcely a field in the technical world in which a knowledge of this metal is not only useful, but necessary.

As Mr. West has had the widest and most intimate association with the iron industry, his word must be taken as authoritative on all subjects with which the smelter and foundryman has to deal.

Covering, as it does, among others of equal importance, the vital questions of molding, testing, mixing, and chemical composition, the work has proved itself well nigh indispensable, as is shown by the fact that it is now in the eleventh edition.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending April 9, 1907.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Abdominal guard and supporter, J. Gamble	849,471
Acids, bromin derivative of fatty, E. Fischer	850,111
Adding machine, G. N. Hinchman	849,476
Adjustable wrench, G. E. Woodbury	849,765
Advertising device, C. M. O'Brien	849,493
Agitator, B. Solis	850,069
Agricultural implement, H. C. Weaver	849,646
Air brake mechanism, C. G. Lundholm	849,550
Air filter and cooler, L. F. Pawley	849,568
Alloy, A. H. Smith	849,927
Amusement device, P. Boyton	849,970
Anchor post and stretcher, F. Underwood	849,441
Anti-pig-rooting device, T. W. Box	849,969
Augur, packing, E. E. Ziegenfuss	849,452
Automatic coupling, P. Lamche	850,090
Automatic sprinkler, Thurlow & Fraser	849,938
Automobile top holder, C. W. Coops	849,598
Automobiles, anti-slipping device for, Nye & Gruesbeck	849,805
Automobiles, differential clutch mechanism for, F. W. Hedgeland	849,474
Axle, G. A. Weaver	849,950
Axle construction, front, G. E. Babcock	849,652
Back spacing mechanism, W. W. Torrence	850,106
Bait, artificial, B. F. Burke	849,367
Bait, artificial fish, E. C. Adams	849,522
Baling press, J. A. Carney	849,658
Baling press, H. L. Whitman	849,874
Baling press, J. A. Spencer	850,105
Ball back stop, base, W. S. Titus	849,941
Ball marker, golf, J. C. Cory	849,600
Balls, making playing, F. H. Richards	849,572
Bank, savings, E. E. Forest	849,469
Bar. See Grate bar.	
Barrel and box carrier, J. A. Wright	849,449
Barrel cover or lid support, Madole & Boerner	849,552
Basket, fruit picker's, F. Cartmel	849,976
Basket handle, J. B. Kenny	849,402
Beam, G. B. & G. D. McLean	849,917
Bearing, colter, T. R. Wallis	849,948
Bearing, roller, A. J. Morse	849,488
Bed, bottom, spring, J. Reilley	850,118
Bed, folding, S. E. Twitchell	849,943
Bed, folding, Schauer & Graff	850,103
Bed pan, H. Gold	849,472
Bed rail joint, iron, W. L. Fredericks	849,537
Bed, spring, I. H. Haas	849,541
Bedclothes holder, L. E. Henry	849,902
Bedstead, couch, J. H. Dyett	850,121
Belt, conveyor, Houchin & Huber	850,002
Benzin, etc., apparatus for recovering, A. E. Vincent	849,645
Beverage making device, D. S. Holley	849,613
Binder, loose leaf, W. Shallcross	849,430
Binder, loose leaf, H. G. Buchan	849,973
Binder, temporary, E. G. Dow	849,836
Block making apparatus, molded, J. O. Winston	849,824
Boat, U. R. Miller	850,034
Bobbin holder, A. E. Rhoades	850,099
Boiler tube scraping apparatus, A. G. Hay	849,898
Boring machine, F. H. French	850,085
Bottle, F. Hayden	849,899
Bottle, C. E. Justison	850,015
Bottle, F. Smith	850,067
Bottle closure, J. B. Short	849,509
Bottle closure, A. E. Batchelder	849,960
Bottle, electrically heated hot water, H. W. Christian	849,368
Bottle filling machine, S. M. Heulings	849,735
Bottle stopper or cork extractor, J. B. Short	849,508
Box, T. G. Palmer	850,095
Box handle, N. L. Barmore	849,358
Bracelet, I. M. Sylvester	849,755
Bracket, H. E. Holland	849,398
Brake shoe, C. W. Booth	849,722
Branding machine, sheep, J. A. Magelssen	849,691
Brick handling implement, hollow, C. S. Hall	849,897
Brick mold, F. Mueller	850,038
Broiler, J. W. Ross	850,058
Broom corn saw machine, A. J. Middleton	849,804
Bucket for dredging purposes, scoop, C. Pay	850,096
Buckle and cockeye for harness traces, combination, E. B. Knapp	850,115
Buckle attachment for straps, J. Van Cleve	849,516
Buckle, cross line, F. W. T. Mitchell	849,486
Building block, S. T. Playford	850,048
Building block for chimneys, E. C. Newell	849,694
Building purposes, anchorage for, R. P. Smith	849,817
Buoy, W. C. Beebe	849,362
Buoy, life saving, W. F. Clark	849,887
Burner, B. A. Baxter	849,359
Button, A. J. Levy	849,740
Button cutting and sawing machine, automatic, J. W. Miller	850,033
Buttons, brooches, belt clasps, and buckle-fronts from horn and hoof, manufacture of, F. H. Grove	849,608
Cables, steel supporting structure for electric transmission, A. K. Mansfield	849,908
Calcining furnace, T. McNeal	850,041
Camera stand, K. Nelson	849,557
Can cover fastener, C. E. Bertels, reissue	12,629
Can opener, A. G. Snowdon	849,929
Can top, powder, J. H. Goss	850,086
Canopy frame, I. E. Palmer	849,808
Canopy, ventilating, W. L. Hofer	849,611
Cant hook or peavey, P. Price	850,051
Car, ballast, Proctor & Gnaegy	849,854
Car construction, F. M. Brinckerhoff	849,827, 849,828
Car construction, passenger, F. M. Brinckerhoff	849,826
Car coupling, J. R. Mitchell	849,412
Car cover, railway, G. A. Heimbucher	849,785
Car draft rigging, railway, S. D. Wright	849,619
Car draft rigging, railway, W. Slayden	849,926
Car friction draft rigging, railway, J. F. O'Connor	849,561, 849,562
Car friction spring draft rigging, railway, J. F. O'Connor	849,560
Car mover, M. N. Shell	849,923
Car, railway, D. L. Minier	849,411
Car replacer, C. H. Hess	849,393
Car roller side bearing, railway, F. B. Townsend	849,515
Car roof, W. J. Wheeler	849,518
Car roof frame, box, Emerick & Bundy	849,382
Car seats and the like, rail connection for, E. G. Budd	849,657
Car step, L. Yeager, Jr.	849,955
Car step, extension, N. Stevens	850,072
Carbureter, P. Gaeth	849,538
Card feeding device, automatic, W. A. Billman	849,655
Card sorting device, D. Kent	849,622
Carpet stretcher, C. Helm	849,997
Carrier. See Barrel and box carrier.	
Cash checking machine, E. Guess	849,473
Cash regster, E. Van Camp	849,869
Casket handle, W. T. Fisk	849,669
Caster, W. Imbt	850,009
Catamenial bandage, M. A. Cook	849,725
Cement block machine, J. W. Herring	849,392
Cement for resisting water, impermeable, G. Frollo	849,778
Cement kiln, J. S. Wentz	849,873
Cement post, W. E. Varney	849,759
Cement post mold, W. E. Varney	849,760
Chair and table, combination, C. O. Hoffmann	849,397
Chair head rest, barber's, B. F. Buchanan	849,595
Chalk line holder, M. A. Reare	850,052
Clock, J. M. Thomas	849,937
Churn and butter worker, G. J. Kuplan	849,688
Cipher code, telegraph and cable, F. W. Lietzow	850,091
Circuit changing mechanism, H. G. Webster	849,443
Clamp, J. C. Adams	849,354
Clamp, J. B. Danforth	849,980
Clamping ring, J. Clark	849,370, 849,371
Cleaning apparatus, A. E. Sadler	849,641
Cleat, wire, J. W. Steele	849,930
Cleaver and meat tenderer, combined, F. White	849,648
Clothes line fastener, L. C. A. Denlea	849,983
Clothes line support, J. H. Ruehmling	849,428
Clothes line support and holder, Windt & Mattika	849,876
Clutch, A. J. Morse	849,487
Clutch, Potter & Johnston	849,697
Coaches, skirt guard for baby, Fiske & Smith	849,839
Cocks, pressure regulator for gas, M. W. Longfellow	849,406
Coffee pot, C. M. Overcash	849,564
Coin operated mechanism, J. J. Wood	849,447, 849,448
Coke separating and discharging apparatus, W. Schumacher	849,429
Coking briquets, apparatus for, B. Wagner	849,947
Column, metal, R. B. White	849,951
Combination wrench, E. Ellingson	849,891
Concrete block machine, A. O. Thomas	849,704
Concrete blocks, curing, J. W. Jackson	849,790
Concrete building blocks, manufacturing, S. W. Hendrickson	850,112
Concrete ceilings, hanger support for, A. J. Perkins	850,097
Concrete construction, reinforced, E. M. Scofield	849,922
Concrete form, J. M. Carmody	849,835
Concrete mixer, E. E. Flora	849,739
Concrete wall mold, W. H. Anthony	850,120
Condenser, sectional, W. Van den Heuvel	849,944
Condenser, surface, C. N. Tatarnicoff	849,866
Conduit box, C. A. Hinsdill	849,395
Conduit coupling, electrical, J. A. Neth	849,417
Conduits, plug for sealing underground, W. L. McGowan	849,415
Connecting rod head, W. W. Sleeman	849,642
Convertible table, F. A. Richter	850,056
Conveyor, cross, C. Bradford	849,591
Conveying apparatus, F. H. Wolever	850,107
Cooker, A. Major	850,028
Cooker, A. K. Schulte	850,060
Cooling apparatus, W. Helm	849,998
Cooling attachment, T. A. Alton	849,711
Core separator, J. P. Maffett	850,116
Corn, apparatus for the treatment of seed, P. Paulsen	849,567
Corn, device for testing the germinating power of seed, A. R. Francis	849,671
Corn thinner, J. P. Bennett	849,654
Corset attachment, N. Stoskopf	849,583
Corset busk, R. E. Legge	849,905
Counter die and making same, P. & M. Lehnert	849,517
Crane, A. V. Kiser	849,403
Creel, I. E. Palmer	849,810
Cultivator, W. C. Hinton	849,366
Cultivator attachment, J. J. Young	849,956
Curtain fixture, A. G. W. Brown	849,972
Curtain pole, J. C. Renn	849,855
Curtain rod, C. W. Kirsch	850,089
Curtain stretching and drying device, lace, A. Proctor	849,853
Cushion wheel, J. P. Holder	850,000
Cuspidor, N. R. Thibert	850,076
Cut-off and drainage apparatus, W. H. Ellis	849,534
Cut-off, automatic, J. D. Patton	849,637

Cycle driving and braking mechansm, H. P. Townsend 850,077
Deck plate, A. R. Hurlburt 849,618
Dental tools, guard and moistener for, C. A. Sevier 849,702
Desk, hotel register, F. F. Dolesby 849,603
Die. See Counter die.
Die stock reamer attachment, F. S. Barnes 849,880
Dish washing machine, J. Krehbiel 849,627
Display cabinet, M. T. Brennan 849,656
Display rack, T. E. Arnold 849,589
Display stand, J. B. Gordon 849,676
Distilling, concentrating, and evaporating liquids, J. E. Siebel 849,579
Ditching machine, M. P. Carpenter 849,458
Dock, floating dry, W. T. Donnelly 849,378
Doll, S. A. West 849,588
Door catch, G. W. Mallory 849,692
Door for cold storage rooms, swing, J. F. Drucker 849,775
Door, metal, A. Mandry 849,742
Door stop and lock, C. J. Tatum 849,932
Dough dividing and scaling machine, F. Streich 850,074
Draft equalizer, O. J. Boe 849,364
Draft equalizer, H. W. Bourret 849,526
Draft rigging, C. J. Nash 849,556
Drinking trough, J. Dintaman 849,728
Drum attachment clamp, Wanamaker & Leedy 849,517
Drying frame and stretcher, O. J. Katz 850,016
Drying machine, J. M. Spencer 849,581
Dust guard, H. Bensch 849,963
Dye and making same, yellow monoazo, A. L. Laska 849,739
Dye, yellow wool, A. L. Laska 849,690
Egg tester, C. Lingemann 849,405
Electric circuit drop, W. H. Robins 850,101
Electric igniter, W. H. Blood, Jr 849,593
Electric machine, dynamo, S. S. Forster 849,670
Electric machine, dynamo, E. F. W. Alexanderson 849,713
Electric machines, composition or compound for brushes of dynamo, C. W. Spiers 849,643
Electric machines, cooling dynamo, Whitney & Tirrill 849,706
Electric machinery, brush for dynamo, C. W. Spiers 849,511
Electric motor regulation, R. Stebbins 849,582
Electric switch, E. M. Hewlett 849,684
Electric switch and air gage, automatic pressure controlled, L. H. Westphal, 849,762, 850,081
Electrical distribution and regulation system, W. A. Turbayne 849,705
Electrical distribution system, self-regulating, W. A. Turbayne 849,644
Electrical indicating apparatus, A. A. Radtke 849,698
Electrical rosette, G. B. Thomas 849,934
Electro-magnetic apparatus, E. Bachelet 849,653
Elevator safety attachment, A. J. Hallstein 849,610
Elevator system, multiple, C. Foster 849,840
Emergency brake, automatic, W. Cooper 849,599
Engine igniter, explosive, E. P. Lamb 849,797
Engine lubricator, explosive, J. Powell 849,495
Engine spark ignition system, explosion, R. Varley 849,820
Engine sparking device, internal combustion, F. W. Brady 849,769
Engine sparking mechanism, gasoline, H. E. Atwater 849,716
Eraser, ink, T. Draper 849,985
Explosive, O. Silberrad 849,925, 850,119
Extractor. See Bottle stopper or cork extractor.
Eyeglass mounting, L. F. Adt 849,710
Eyelets with a flexible material, covering, P. R. Glass 849,605
Fabrics, trimming for the edges of, J. D. Morley 849,693
Feed water controlling apparatus, J. E. L. Ogden 850,045
Fence builder, wire, W. S. Hazelton 849,390
Fence machines, feed mechanism for wire, P. Frantz 849,672
Fence post, J. E. Wright 850,082
Fibers with liquids and gases, apparatus for treating textile, J. O. Obermaier 849,635
Filament forming apparatus, M. Waddell, 849,822, 849,870
Filaments and films from viscose, manufacture of, C. N. Waite 849,823
File, E. G. Dow 849,774
File cutting machine, J. Beche 849,361
Filter for eaves troughs, L. M. Galliher 849,674
Fre escape alarm, S. Ashford 849,651
Fire kindler, J. H. McDonough 849,915
Firearm, R. E. Flyberg 849,536
Firearm hammer lock, M. V. Allen 849,825
Firearm safety device, C. H. Hansen 849,387
Firearm sight, R. E. Reardon 849,498
Fireproof column, J. J. Tresidder 849,819
Fireproof wall, ventilated, L. D. Ewing 849,776
Fish stringer, A. C. Mills 849,410
Fishing rod and cane, combined, J. M. Lobit 849,481
Fishing tackle, S. D. Martin 849,743
Floral design, L. J. Olden 849,696
Flue stop, C. W. Reynolds, Jr 849,640
Fluid heating apparatus, A. Zivi 849,878
Fluid pressure motor, E. Badcock 850,108
Flushing tank, C. Willms 849,708
Flying apparatus, A. Brandl 849,971
Folding chair, C. J. Van Valkenburg 849,584
Foot protecting device, C. E. Passage 849,811
Force draft, N. S. V. Hamel 849,678
Forehead and ear protector, M. E. Lineweaver 849,548
Formaldehyde preparations, producing, P. Rosenberg 849,815
Freezer and refrigerator car, combined, O. M. Stimson, reissue 12,630
Fruit, apparatus for processing, W. C. Anderson 849,650
Furnace, N. Johnson 849,686
Furnace, J. Cromie 849,890
Furnace, W. McClave 849,912
Furnace for burning soft fuels, J. E. Parkison 849,566
Game, G. Santen 849,857
Game device, A. Oppenheimer 849,806
Game table, R. B. Cantrell 849,974
Garment pattern, adjustable, W. M. Barry 849,959
Garment supporter, B. H. White 849,763
Garment supporter, H. G. Macwilliam, 849,801, 840,906
Gas burner, heating, F. G. Nicolaus 849,634
Gas cooler, C. B. Clark 849,369
Gas lighter and extinguisher, automatic, N. Corbeil 849,889
Gas producer, W. R. Miller 849,848
Gas purifying, acetylene, G. F. Jaubert 850,010
Gasoline indicator, W. F. Pagel 850,807
Gate controlling means, safety, C. S. Heller 849,842
Gear, reversing, P. Daimler 849,372
Glass, drawing sheet, Colburn & Player 849,531
Glass, method and means for the manufacture of wire, Carter & Beebe 849,459
Glass press, T. J. Conway 849,461
Gluing machine, C. P. Freestate 849,777
Gold and platinum from other material, machine for separating, C. O. Michaelsen 849,553
Gold washing and saving apparatus, G. L. Holmes 849,614
Grain and straw separator, J. Hutcheson 850,008
Grain bin, T. Dougherty 849,984
Grain separator and bolter, J. W. Smith 849,863
Grain shocker, J. G. Stewart 849,931
Graphophones and the like, needle for, F. Petmecky 849,425
Grate, W. McClave 849,914
Grate bar, C. H. Eaton 849,986
Grate mechanism, stoking, W. McClave 849,913
Gravers and other tools, sharpening holder for, W. E. & F. W. Crocker 850,084
Grinding and grating apparatus, W. W. Smith 850,068
Grinding and pulverizing apparatus, B. Hunt 849,545
Grinding machine, Henry & Althoff 849,391
Grinding machine, Kinstle & Peck 849,626
Grinding machine, A. Johnston 850,014
Gun cleaning implement, C. Hildenbrand 849,786
Gun sight, F. A. Schanz 849,504
Hair comb, E. A. Baker 849,766
Hair curler, electrical, H. Deierl 849,981
Hammer, H. Lewis 850,024
Harrow disk, J. R. Grigg 849,386
Harrow scraper, disk, A. C. Gaylord 849,993
Harrow tooth, D. M. Smith 849,928
Harvesters, platform flag for, W. Webber 849,442

Harvesting machine attachment, O. L. Kleven	849,689
Harvesting machine, hay, B. Smith	849,580
Hat, separable, R. F. Bartel	849,591
Hatcher, P. J. Sprague	849,433
Hay curing rack, H. E. Bell	849,962
Hay loader, J. E. Norris	850,042
Hay press, J. W. Carter	849,528
Heating system, W. L. Miller	849,744
Heel clip, H. A. L. Heinichen	849,901
Hem finder, G. F. Oldham	849,636
Hitching strap clamp, G. Ritz	849,573
Hoisting device, M. Metzger	849,485
Hoisting mechanism, G. W. King	849,625
Hook. See Cant hook.	
Hoop former, barrel, T. Johnson	849,400
Horse arrester, J. T. Lambert	849,631
Horse releaser, A. W. Caswell	849,886
Horseshoe, H. Adelman	849,879
Horseshoe, H. Dahms	849,979
Hose winding machine, metallic, W. Schwarz	849,858
Hot water heater, M. J. Selzer	850,062
Hub, cushion, J. A. McManus	850,040
Hydroscope, G. Pino	849,570
Ice breaking machine, rotary, G. M. Mills	850,093
Ice door, R. E. Jones	849,687
Ice making machine, J. Souther	849,864
Ice plow, G. M. Hoke	849,544
Indicator, G. Brown	849,456
Indicator, M. J. Lynch	850,027
Ingot heating furnace, water sealed continuous, W. R. Miller	849,909
Ink saving adjustment, F. C. Johnson	849,685
Inkstand, C. H. Numan	849,419
Insulator, A. Goldstein	849,606
Insulator, S. Feuerstein	849,731
Insulator, C. Griffith	849,896
Irrigator, automatic, R. C. Schroedter	849,505
Jack, J. Humphreys	849,788
Journal box, car, A. V. Peppard	850,047
Kiln, J. A. Schumaker	850,066
Knitting machine, fleeced rib, R. W. Scott	849,701
Lamp bracket, W. P. Crary	849,727
Lamp burner, A. H. Handlan, Jr.	849,679
Lamp support, incandescent electric, J. Sullivan	849,754
Lap robe, A. H. Kinder	849,624
Latch, gate, T. E. Harner	849,680
Lath, metal, J. M. Rude	849,427
Lathing, T. E. Ritchie	849,856
Lathing machine, sheet, J. D. O'Brien	849,422
Lathing sheet, wood, J. D. O'Brien	849,421
Lathe attachment, turning, J. Morgan	850,035
Lathe, boring, E. Mueller	849,414
Lathe milling attachment, G. Amonsen	849,355
Lathe tool, F. F. Tifft	849,940
Lawn sprinkler, F. M. Huntoon	850,007
Leaf support, O. R. Hunt	849,736
Lens, also applicable as double objectives, single cemented objective, O. G. Heimstadt	849,900
Lens, fresnel, W. Churchill	849,977
Letter sheet and envelope, combined, W. A. Cooke, Jr.	849,771
Lifting jack, J. R. Edwards	849,381
Lifting jack, J. G. Owen	849,565
Light reflecting device, P. J. Schelb	849,700
Linotype machine, D. S. Kennedy	849,795, 850,114
Liquid meter, H. N. Denny	849,602
Liquids, means for preventing waste in dispensing, H. S. Cornish	849,462
Load trimmer, T. Irwin	849,477, 849,478
Loading apparatus, J. W. Atkison	850,083
Lock, H. C. Warwick	849,587
Lock and latch mechanism, B. Phelps	849,569
Lock switch, J. A. Mallette	849,907
Locks, etc., keeper for door, C. H. Spencer	849,865
Locomotive diaphragm, G. L. Prentiss	849,496
Locomotive, electric, E. A. Sperry	849,432
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Vehicle brake, W. H. & C. S. Heavlin 849,682
Vehicle brake, H. S. Parker ...... 849,91[illegible]
Vehicle driving and steering mechanism, motor, H. G. Coykendall 849,662
Vehicle frame, O. Stolp 850,073
Vehicle, motor, Magie & Winters 849,483
Vehicle, motor, L. C. Lull 849,549
Vehicle, motor, C. Kohlmyer 850,018
Vehicle wheel, A. A. Daugherty 849,373, 849,374
Vehicle wheel, E. O. Barnes 849,525
Vehicle wheel, C. S. Morse 849,849
Vehicles, controller for electrically propelled, J. S. Raworth 849,749
Vehicles, double acting sprag for, H. B. Stillman 849,512
Vending machine, coin controlled, A. D. Grover 849,609
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Violin chin rest plate, F. W. Becker 849,961
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Vise, J. C. Titus 849,758
Vise, J. Jewitt 849,792
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Vise, Boley & Pfleiderer 849,968
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Wagon top, Gilleland & Stanley 849,675
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Water motor, J. Scott 849,859
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Weather strip, S. P. Bricker 849,366
Weather strip, metal, S. P. Bricker 849,365
Wells, raising liquids from, F. J. Moser ... 850,037
Wheel. See Cushion wheel.
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Wrench, G. Roach 849,813

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Buttons, polished steel, Huet & Ligier 61,897
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Flour, wheat, New Prague Flouring Mill Co., 61,905, 61,906
Flour, wheat, Wells Flour Milling Co., 61,915, 61,916
Flour, wheat, Monte Vista Milling & Elevator Co 61,929
Flour, wheat, Phoenix Mill Co 61,952, 61,953
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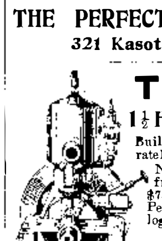

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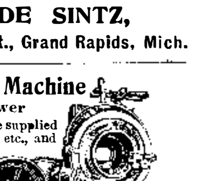

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E. B. ROGERS, Paymaster-General U. S. N. 4-10-07.